

**A TAXONOMIC REVISION OF THE FAMILY
LENTIBULARIACEAE IN INDIA**

THESIS SUBMITTED TO THE
BHARATHIAR UNIVERSITY



**FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY (Ph. D.)
IN BOTANY**

by

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1988

DECLARATION

This is to declare that the thesis presented is a record of research work done by me during the period of study and that the work has not been submitted and formed the basis of the award of any other degree, diploma, associateship, fellowship, or other similar title.

COIMBATORE

30 September, 1988

M. K. Janarthanam

(M.K. JANARTHANAM)

CERTIFICATE

This is to certify that the thesis entitled, "A Taxonomic revision of the Family Lentibulariaceae in India" is a record of original and independent research work done by the candidate Shri Janarthanam, during the period of study under my supervision and guidance in Botanical Survey of India, Southern Circle, Coimbatore and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title.

Dr. A.N. Henry

COIMBATORE

30 September, 1988

(Dr. A.N. HENRY)

Supervisor

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LIST OF FIGURES, MAPS, PHOTOGRAPHS AND TABLES

A. FIGURES:

1. Foliar organs
2. Traps, bracts & bracteoles
3. Capsules & seeds
4. *Pinguicula alpina* L.
5. *Utricularia albocaerulea* Dalzell
6. *U. aurea* Lour.
7. *U. australis* R. Br.
8. *U. baouleensis* A. Chev.
9. *U. bifida* L.
10. *U. brachiata* Oliver
11. *U. caerulea* L.
12. *U. cecilii* Taylor
13. *U. exoleta* R. Br.
14. *U. furcellata* Oliver
15. *U. graminifolia* Vahl
16. *U. hirta* Klein ex Link
17. *U. keralensis* M.K. Janarthanam
18. *U. kumaonensis* Oliver &
U. multicaulis Oliver
19. *U. lazulina* Taylor
20. *U. malabarica* M.K. Janarthanam & A.N. Henry
21. *U. minor* L.
22. *U. minutissima* Vahl
23. *U. nayarii* M.K. Janarthanam & A.N. Henry
24. *U. polygaloides* Edgew.

25. *U. praeterita* Taylor
26. *U. Pubescens* Smith
 U. subulata L.
27. *U. purpurascens* Graham
28. *U. recta* M.K. Janarthanam
29. *U. reticulata* Smith
30. *U. roseopurpurea* Stapf ex Gamble
31. *U. scandens* Benj.
32. *U. smithiana* Wight
33. *U. stellaris* L.f.
34. *U. striatula* Smith
35. *U. uliginosa* Vahl
36. *U. wightiana* M.K. Janarthanam

B. MAPS:

1. Physiography of India
2. Political units of India
3. Distribution: *Pinguicula alpina* L., *Utricularia albocaerulea* Dalzell, *U. arenaria* A. DC. & *U. aurea* Lour.
4. Distribution: *Utricularia australis* R. Br., *U. baouleensis* A. Chev., *U. bifida* L., *U. brachiata* Oliver & *U. caerulea* L.
5. Distribution: *Utricularia cecilii* Taylor, *U. exoleta* R. Br., *U. furcellata* Oliver & *U. graminifolia* Vahl

6. Distribution: *Utricularia hirta* Klein ex Link ,
U. keralensis M.K. Janarthanam, *U. kumaonensis*
 Oliver, *U. lazulina* Taylor, *U. malabarica* M.K.
 Janarthanam & A.N. Henry, *U. minor* L. & *U. minutis-*
ssima Vahl
7. Distribution: *Utricularia multicaulis* Oliver,
U. nayarii M.K. Janarthanam & A.N. Henry, *U. poly-*
galoides Edgew., *U. praeterita* Taylor, *U. pubescens*
 Smith, *U. purpurascens* Graham & *U. recta* M.K.
 Janarthanam
8. Distribution: *Utricularia reticulata* Smith, *U.*
roseopurpurea Stapf ex Gamble & *U. scandens* Benj.
9. Distribution: *Utricularia smithiana* Wight, *U.*
stellaris L.f. & *U. striatula* Smith.
10. Distribution: *Utricularia subulata* L., *U. uligi-*
nosa Vahl & *U. wightiana* M.K. Janarthanam

C. PHOTOS:

1. *Utricularia albocaerulea* Dalzell - Holotype
2. *U. aurea* Lour.
3. *U. australis* R. Br. - Holotype
4. *U. brachiata* Oliver - Lectotype
5. A. *U. caerulea* L., B. *U. recta* M.K. Janarthanam,
 C. *U. minutissima* Vahl, D & E. *U. ceciliai* Taylor,
 F. *U. uliginosa* Vahl & G. *U. lazulina* Taylor
6. A. *U. furcellata* Oliver, B. *U. striatula* Smith,
 C. *U. caerulea* L. & D. *U. roseopurpurea* Stapf
 ex Gamble

7. *U. cecilii* Taylor - Holotype
8. *U. exoleta* R. Br. - Holotype
9. *U. furcellata* Oliver - Lectotype
10. *U. keralensis* M.K. Janarthanam - Holotype
11. *Diurospermum album* Edgew. (\equiv *Utricularia kumaonensis* Oliver) - Neotype
12. *Utricularia lazulina* Taylor - Holotype
13. *U. malabarica* M.K. Janarthanam & A.N. Henry -
Holotype
14. *U. malabarica* M.K. Janarthanam & A.N. Henry
15. *U. multicaulis* Oliver - Lectotype
16. *U. nayarii* M.K. Janarthanam & A.N. Henry - Holotype
17. *U. praeterita* Taylor - Holotype
18. *U. purpurascens* Graham - Neotype
19. *U. recta* M.K. Janarthanam - Holotype
20. *U. roseopurpurea* Stapf ex Gamble - Lectotype
21. *U. smithiana* Wight - Holotype
22. *U. stellaris* L.f. - Holotype
23. *U. subulata* L. - Holotype

D. TABLE:

1. Individual characters leading to the identification of species

C O N T E N T S

	PAGE
I INTRODUCTION	
1. Reasons for undertaking the study	1
2. The area of study	3
3. Historical review	5
3.1. Systematic position	5
3.2. Segregation of genera	6
3.3. Species and infra-specific taxa reported from the area	9
4. Materials and methods	14
5. Plan of the thesis	16
6. Observations and discussions	18
6.1. Morphology and variations	18
6.2. Ecology	33
6.3. Chromosomes	39
6.4. Pollen	41
6.5. Characters used in the key	42
6.6. Taxa recognised in the work	44
6.7. Taxonomy and phylogeny	45
II SYSTEMATIC TREATMENT	49
III CONCLUSIONS	202
IV SELECTED BIBLIOGRAPHY	208
V INDEX TO COLLECTORS	228
VI INDEX TO GENERA, SPECIES AND INFRA-SPECIFIC TAXA	246
APPENDIX : REPRINTS OF PUBLICATIONS	

I INTRODUCTION

1. REASONS FOR UNDERTAKING THE STUDY:

The legendary man-eating trees of Africa and Madagascar have long fascinated the popular press as well as the lay public. Though it is mythical, there are about 400 species of carnivorous plants, all herbaceous, belonging to five families of Angiosperms capable of trapping and digesting insects and animalcules. Among them the family Lentibulariaceae accounts for about 250 species. Of these, the cosmopolitan genus Utricularia L. with nearly 180 species is the largest and widely distributed mostly in tropical, subtropical and a few in temperate zones. About 50 species belonging to the genus Pinguicula L. of the family are mostly centred in the Mediterranean region. Genlisea St. Hil. having 16 species is confined to tropical South America and Africa. Polypompholyx Lehm. with two species is endemic to Australia. This curious family was little studied in India from the taxonomic point of view, and much confusion existed on the identity and nomenclature of several species.

Oliver (1859) in his revisionary account treated 26 species of Utricularia and appended one species of Pinguicula. Later, Clarke (1884) recognised one species of Pinguicula, and 22 species of Utricularia (and 10 imperfectly known species) for the then British India, including present India proper, and areas of Pakistan, Bangladesh, Nepal, Bhutan, Burma, Malaya and Sri Lanka. Moreover due to the paucity of materials these publications could provide only

inadequate descriptions and inaccurate concept of species resulting in much confusion on the identity and nomenclature of several species.

The reorganization of Botanical Survey of India in 1954 at Calcutta and opening of regional circles and field stations throughout the country have greatly helped in exploring the area under study. The specimens accumulated in Central National Herbarium at Calcutta and in regional herbaria of different circles however could not be correctly identified, due to the inaccurate keys and descriptions found in the earlier floras. Being a highly specialized and much variable group which needed time-consuming collection procedures, the general plant collectors could not pay much attention to this group; the importance of vegetative organs was also not recognised in the field. These have resulted in herbarium sheets, mostly with inflorescences without vegetative parts, faithfully pasted upon.

Further, it was observed that the various Utricularias, both aquatic and terrestrial, exhibit a high degree of variation in each of their features, leading to much confusion on their taxonomy and nomenclature. A detailed taxonomic revision of the family Lentibulariaceae for India was therefore felt essential and hence this challenging work was undertaken.

2. THE AREA OF STUDY:

The study area is restricted to the political boundaries of India, which covers an area of 3,267,500 sq. km, lying between 8°4' and 37°6' N. latitudes and between 68°7' and 97°25' E. longitudes. The mainland extends to 3,214 km from north to south and to 2,933 km from east to west. India being the seventh largest country in the World, the land frontier stretches to 15,200 km and coastline to 6,083 km. It is bounded by the Himalayan ranges in north and northeast, Bay of Bengal in southeast, Arabian sea in southwest and Indian Ocean in south and politically bounded by Pakistan in northwest, Afghanistan, China, Nepal, Bhutan in north, Burma in east and southeast and enclosing Bangladesh in east.

Geologically, it consists of three crust blocks: 1. Peninsular India, 2. Himalayan ranges and 3. Indo-Gangetic Plain. Among these, Peninsular India containing the Deccan plateau is geologically the oldest part of the country's land surface.

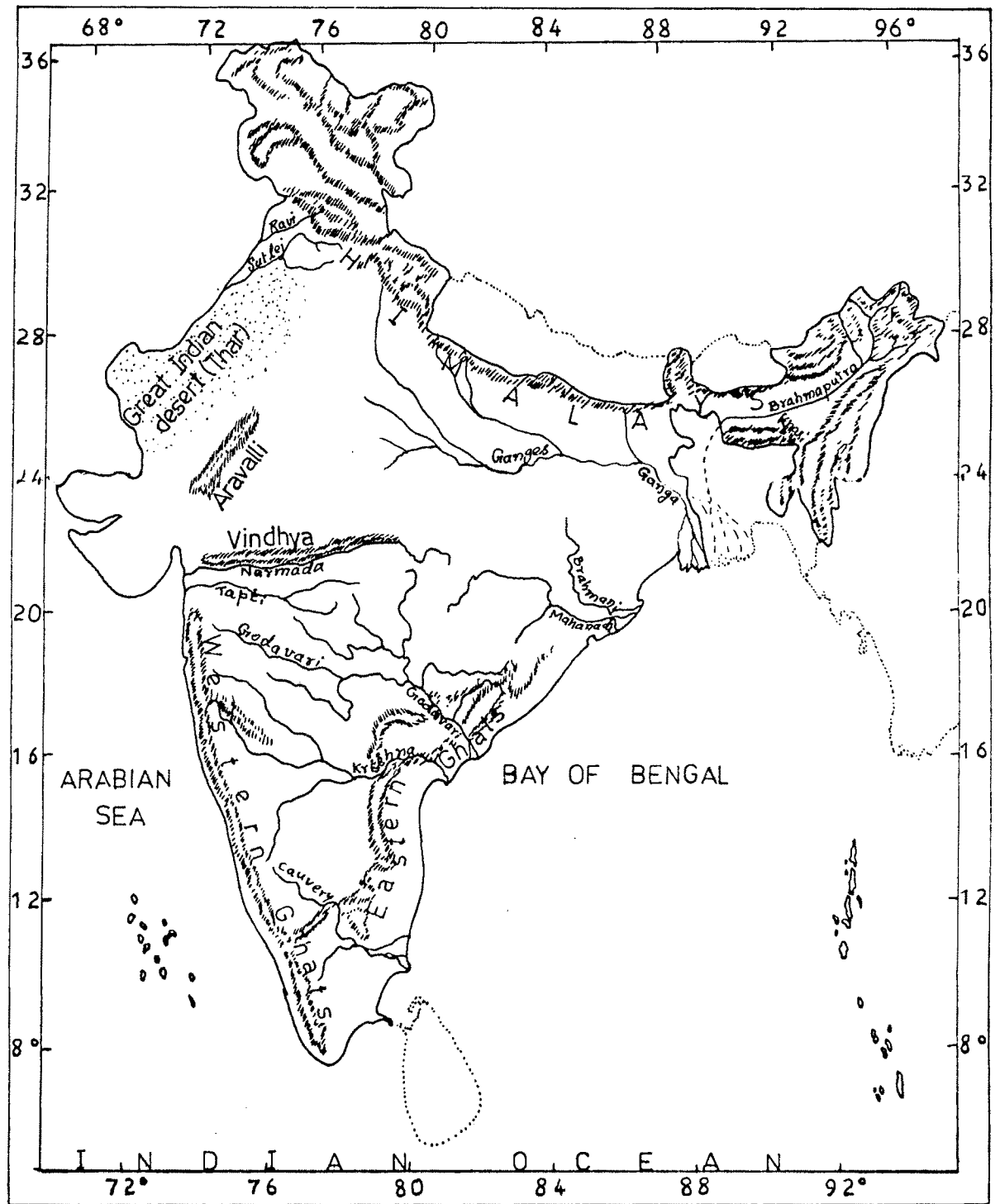
All the major landforms - hills, mountains, plateaus and plains are well represented in India. The principal mountain ranges in the country are: 1. Himalayas, 2. Patkai, 3. Aravalli, 4. Vindhya, 5. Satpura, 6. Sahyadri and 7. Eastern Ghats. Among these the Himalayas harbour most of the World's "eight thousander" (above 8000 m) peaks. They are the World's youngest and longest mountain system,

extending east-west almost uninterruptedly for a distance of 2,500 km and covering about 500,000 sq. km. Glaciers are seen in the snowline between 4,000 and 6,000 m. in the Himalayas. These snowfields are the largest outside the polar region. The plains of India are the most important types of landforms from the standpoint of human use, which covers more than one million sq. km. They are extensively cultivated and densely populated wherever water is available. The river system includes the major rivers like the Indus, the Ganges, the Brahmaputra, the Mahanadi, the Godavari, the Krishna and the Cauvery. Apart from these, large lakes are present at all altitudes. (Map 1).

Climate: The temperature ranges from the average lowest of -34°C in Dras to the average highest of 47°C in Mainpuri and Ludhiana. However the highest temperature recorded was 50°C on June 14, 1934 in Ganganagar.

Seasons: Each year can be conveniently divided into following four principal seasons: 1. Cold weather season - December to February; 2. Hot weather season - March to May; 3. Southwest monsoon season - June to September and 4. Retreading southwest monsoon season - October to November.

Rainfall: Almost the whole of the subcontinent experiences the southwest monsoon during June and July. The northeast monsoon also contributes to a certain extent. These two monsoons are important for the Utricularias as they sprout



Map 1. Physiography of India

up immediately after the rains. A place called Cherrapunji in Meghalaya receives the maximum rainfall in the World which averages to 11,418.7 mm, and the maximum rainfall recorded was 15,706.6 mm in the year 1951. The rains are minimum in the desert region of Rajasthan and snow covered Leh region of Jammu & Kashmir. Jodhpur recorded the lowest rainfall of 24.4 mm in the year 1899 (Anonymous 1983).

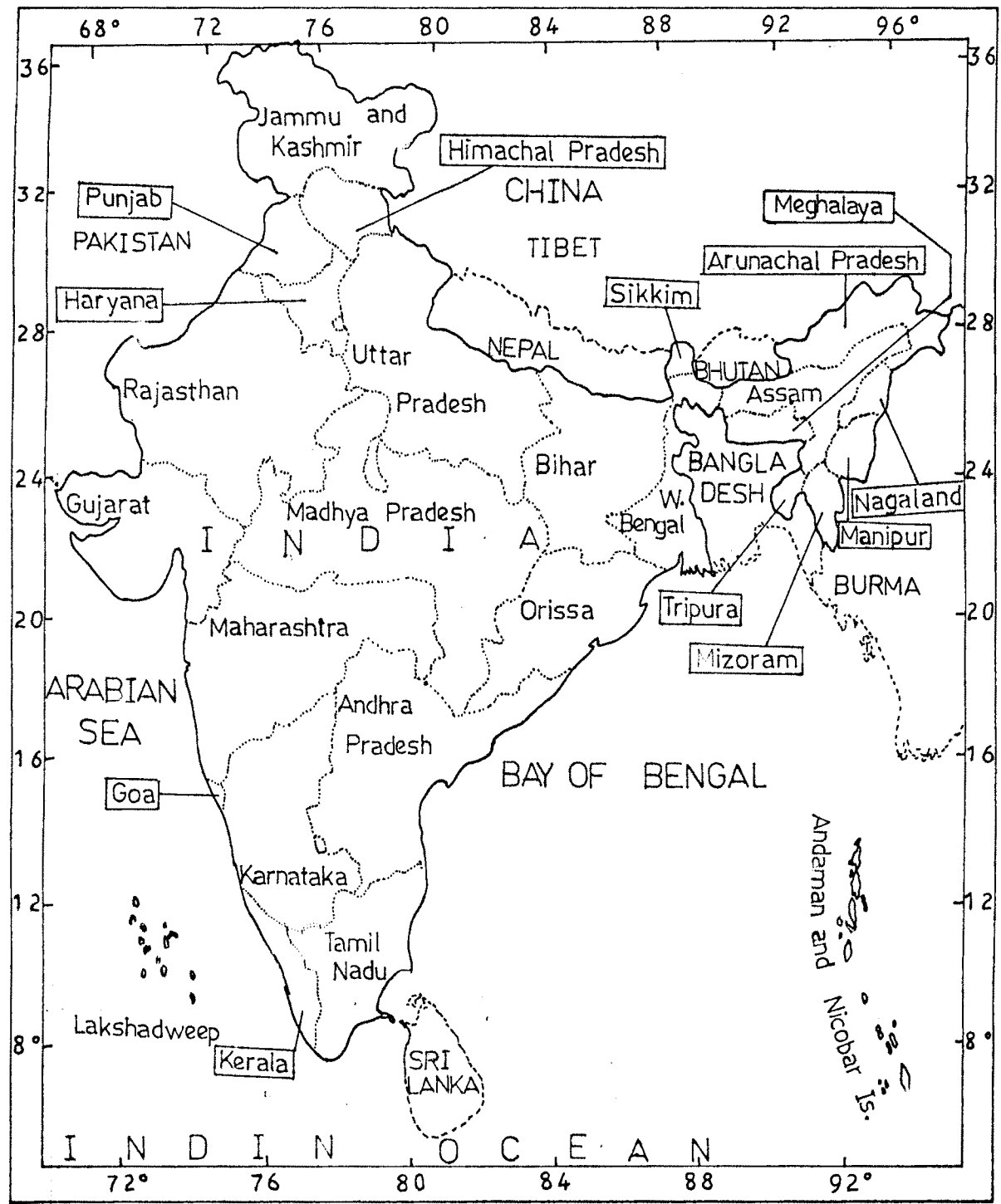
Phytogeographical regions: Clarke (1898), Hooker (1907), Chatterjee (1939) and Razi (1955) have divided India into many phytogeographical regions. Though the number of regions recognised by them varies, the following phytogeographical regions or botanical provinces are recognised by either one or the other: 1. Northwest Himalayas, 2. Western Himalayas, 3. Central Himalayas, 4. Eastern Himalayas, 5. Indus plains, 6. Gangetic plains, 7. Assam region, 8. Central Indian and Deccan plateau, 9. Malabar region and 10. Andaman region.

Politically, India has been divided into twenty five states and seven union territories (Map 2).

3. HISTORICAL REVIEW:

3.1. Systematic position:

Linnaeus (1753) placed the genera Utricularia L. and Pinguicula L. under 'Diandria monogynia' in his artificial system of classification. Bentham & Hooker (1876) included them in Personales. They placed the family Lentibulariaceae,



Map 2. Political units of India

nearer to Primulaceae and Scrophulariaceae. The flower structure of Lentibulariaceae is similar to that of Scrophulariaceae, but the 1-loculed capsule and insectivorous nature make them different. Uniloculed capsule is common to both Primulaceae and Lentibulariaceae. Dickson (1869) remarked "on the whole it seems to me that we have as little right to associate Lentibulariaceae with Scrophulariaceae on account of bilabiate floral envelopes and more or less didynamous stamens, as a zoologist would have to associate the Echnida with Hedgehogs or with Porcupines, on account of the remarkable correspondence in their prickly defence." And according to him ovary in Lentibulariaceae is considered to be composed of five carpels as in Primulaceae, and hence they are more related to each other than to any other family. Hutchinson (1969) included Lentibulariaceae in the order Personales; Takhtajan (1980) treated them under the suborder Scrophularineae of the order Scrophulariales. According to Cronquist (1968) "several families, notably the Orobanchaceae, Gesneriaceae, Globulariaceae, Lentibulariaceae and Acanthaceae, appear to have been derived directly from the Scrophulariaceae.

3.2. Segregation of Genera:

Presently four genera are recognised in the family Lentibulariaceae (Taylor 1977a). But there were many attempts to segregate more genera and further into smaller

units of subgenera and sections. Such an attempt was first done by Rafinesque (1837-38), and he recognised genera like Cosmiza, Meloneura, Vesiculina and Stomoisia. De Candolle (1844) recognised three genera: Utricularia L., Genlisea St. Hil. and Pinguicula L. Based on the habitat and nature of foliar organs, he recognised the sections - Megacista, Lentibularia, Stylotheca, Oligocista and Orchidioides in the genus Utricularia. He included the Indian species U. stellaris L.f. in section Megacista; U. fasciculata Roxb. (= U. aurea Lour.), U. exoleta R. Br. in Lentibularia; and all terrestrial and epiphytic species in Oligocista. The other two sections have no Indian representatives. Among the three sections recognised in the genus Pinguicula, based on colour of the flower and other supplementary characters, P. alpina L. the only species from the Indian region falls under the section Pinophyllum. Benjamin (1847) divided the genus Utricularia into eleven sections.

Kamienksi (1893) recognised two tribes and five genera for the family. The tribe Biovularieae Kam. is monotypic, and Utricularieae Kam. contains four genera viz. Pinguicula, Genlisea, Polypompholyx Lehm. and Utricularia. The tribes were segregated on the basis of the number of ovules and seeds. The segregation of genera was based on the number of calyx-lobes. In Pinguicula, he recognised all the sections erected by De Candolle (l.c.). And in Utricularia, he treated 10 sections: Oligocista, Megacista and Orchidioides of De Candolle; Phyllaria Kurz, Lentibularia Gesn.,

and five new sections, viz. Pleiochasia, Macroceras, Foliosa, Avesicaria and Parcifolia. Among these, the Indian species come under (i) Sect. Oligocista [e.g. U. racemosa Wall. (= U. caerulea L.), U. affinis Wight (= U. uliginosa Vahl), U. bifida L. etc.]; (ii) Sect. Phyllaria [e.g. U. orbiculata Wall. (= U. striatula Smith)]; (iii) Sect. Megacista (e.g. U. stellaris L.f.); (iv) Sect. Lentibularia Gesn. [e.g. U. flexuosa Vahl (= U. aurea Lour.)]; and (v) Sect. Parcifolia (e.g.: U. exoleta R. Br.).

Barnhart (1915) recognised many genera in the family. Apart from the conventionally recognised genera [Pinguicula L., Genlisea St. Hil., Cosmiza Raf. (= Polypompholyx Lehm.)], he recognised Biovularia Kam. And according to him "After excluding Pinguicula, Genlisea, Cosmiza and Biovularia there is left in the family a vast assemblage of heterogeneous elements hitherto retained in a single genus, Utricularia, which it is here proposed to dismember". He used the characters like presence or absence of bracteoles, their position, size of the calyx-lobes to each other, fixation of bracts, etc., and recognised 11 genera in Utricularia sensu lato (excluding Biovularia) in which 8 new genera were proposed. The later workers like Santapau (1950) and Taylor (1964) preferred to use them under a single genus Utricularia L.

Komiya (1973) followed Kamienski (1893) in recognising 5 genera. The genera Pinguicula and Genlisea were elevated

to the status of a subfamily. The subfamily Utricularioideae Komiya were divided into two tribes, the monotypic Biovularieae, and Utricularieae comprising the genera Poly-pompholyx and Utricularia. The genus Utricularia was again divided into 8 subgenera and 11 sections. Komiya mostly erected new subgenera or reduced the generic names of Barnhart (l.c.) into subgenera or sections. He selected most of the characters from Barnhart (l.c.).

Thus, there existed a lot of divisions within the family Lentibulariaceae, especially in the genus Utricularia, as it contained various species groups of distinct characters, though the genus as a whole possesses bilobed calyx and traps in common.

3.3. Species and infra-specific taxa reported from the area:

History of the family Lentibulariaceae in India starts with the publication of 'Nelipu' by van Rheede (1689) in his 'Hortus Malabaricus'. Though Linnaeus (1753) published seven species of Utricularia and a species of Pinguicula in his Species Plantarum, none of them was from the area under study. But, he had erroneously included 'Nelipu' of van Rheede in Utricularia caerulea L. described from the specimens collected by Hermann from Ceylon (Trimen 1888; Basak 1979); 'Nelipu' of van Rheede has since been identified as U. reticulata Smith.

Burman (1768) reported U. bifida L. for the first time from India along with U. caerulea. But, again the latter included van Rheede's illustration. U. stellaris L.f. was the first species to be described wholly based on collection made from India by Koenig and described by Linnaeus (filius) in 1781. Willdenow (1797) published U. capillacea Willd. from India, but due to insufficient material its identity could not be established. Just at the end of eighteenth century, Roxburgh (1798) had illustrated U. stellaris L.f. in his Plants of the Coromandel Coast. In the beginning of the nineteenth century, the first monograph of the family appeared, in which Vahl (1804) dealt with 12 species of Pinguicula and 34 species of Utricularia. Among them U. graminifolia, U. flexuosa, U. uliginosa, U. humilis and U. ramosa were the taxa described from India. Roxburgh (1820, 1832) treated U. stellaris L.f., U. fasciculata Roxb., and U. diflora Roxb. in Flora Indica. U. hirta a mss. name based on specimens collected from Southern India by Klein when he was attached to Tranquebar Mission near Madras was validated by Link in 1820. The names in Wallich's Catalogue (1828-1849) were either validated by later authors or published pro synonyms.

De Candolle's Prodrum (1844) dealt with all the species of Utricularia published until then, including many species from India, and he validated many names mentioned in Wallich's catalogue. Graham's catalogue of plants

growing in Bombay and its vicinity (1839) included U. purpurascens Graham and U. pusilla Graham, two additional species in the family. However, John Graham's catalogue did not deal with dried plants in a herbarium (Mabberley 1980). Benjamin (1845, 1847) described U. alata Benj., U. paucifolia Benj., U. scandens Benj., U. squamosa Benj. and U. wallichiana Benj., all from India. Edgeworth (1848) described a monotypic genus Diurospermum Edgew. (Type: Diurospermum album Edgew.), and also Utricularia foveolata Edgew., U. poygaloides Edgew., U. pterosperma Edgew. and U. rosea Edgew. from Bengal. Wight (1849, 1850) illustrated 24 species of Utricularia with notes and a key to the species. Of the above, 22 species were from India proper. U. affinis Wight, U. arcuata Wight, U. brachypoda Wight, U. conferta Wight, U. glochidⁱata Wight, U. macrolepis Wight, U. pedicellata Wight, U. smithiana Wight, U. squamosa Wight, U. uliginoides Wight, U. wallichiana Wight were described by him in the group. Dalzell (1851) described U. albocaerulea Dalz. and U. decipiens Dalz.

Oliver (1859) published the first ever monograph on Indian Utricularias. In the same account he reported Pinguicula alpina L. the only known member in the genus from the Indian subcontinent. He treated 26 species for India, including four new species (viz. U. brachiata Oliver, U. furcellata Oliver, U. multicaulis Oliver and U. scandens Oliver), two new varieties (viz. U. wallichiana Wight var.

firmula Oliver and U. reticulata Smith var. stricticaulis Koenig ex Oliver), and U. kumaonensis Oliver—a new name. Drury (1866) had given a fine account of 17 species including five varieties for India.

Clarke (1884) treated one species of Pinguicula and 22 species of Utricularia (along with 10 names which were imperfectly known) for the whole of the then British India which also included parts of Pakistan, Nepal, Bhutan, Burma, Malaya and Sri Lanka. After, Hooker's Flora of British India (1872-1897), great emphasis was put on regional floras. Prain (1903) included 9 species in his Bengal Plants. Cooke (1905) treated 10 species of Utricularia for the Flora of Presidency of Bombay. Duthie (1911) accounted 4 species for Upper Gangetic Plains, and Haines (1922) listed 9 species for Bihar and Orissa in the family. Gamble (1924) treated 16 species of Utricularia for the then Madras Presidency; U. roseopurpurea Stapf ex Gamble and U. stricticaulis (Koenig ex Oliver) Stapf ex Gamble are two new species described in the work.

Santapau (1950) published an excellent account on Lentibulariaceae of Bombay. Taylor's (1964, 1977a) treatises on African and Malesian Utricularias included some species common to India. Subramanyam (1979) reviewed the work done on Indian Utricularias.

Several new species of Utricularia have been described from India recently. they are U. equiseticaulis Blatter

& McCann and U. ogmosperma Blatter & McCann (Blatter & McCann 1931), U. reticulata Smith var. parviflora Santapau (Santapau 1949, 1950), U. sampathii Subr. & Yog. (Subramanyam & Yoganarasimhan 1981), U. tayloriana Joseph & Mani and U. khasiana Joseph & Mani (Joseph & Mani 1983), U. praeterita Taylor (Matthew 1983), U. cecilia Taylor and U. lazulina Taylor (1984) and U. nayarai M.K. Janarthanam & A.N. Henry (Janarthanam & Henry 1986).

The following species were also recorded from India: U. lilliput Pellegrin (Subramanyam & Balakrishnan 1960), U. minutissima Vahl (Vasudevan Nair 1965), U. pubescens Smith (Saxena 1965; Rao & Joseph 1967), U. arenaria A. DC. and U. australis R. Br. (Saxena 1966, 1970), and U. stanfieldii Taylor (Joseph & Mani 1982).

Papers dealing with various aspects of morphology, taxonomy and nomenclature have been published by Abraham & Subramanyam (1965), Joseph & Ramamurthy (1961), Subramanyam (1962, 1977), Abraham et al. (1974), Subramanyam & Banerjee (1968), Basak (1976, 1979), Subramanyam & Yoganarasimhan (1979), Bhattacharyya (1976, 1986), Mehrothra & Chakraborty (1985), Srivastava (1983), Robins & Subramanyam (1980) and Janarthanam & Henry (1987). Apart from these, several State/District floras of India have also contributed to the morphology, taxonomy, ecology and distribution of the family Lentibulariaceae.

4. MATERIALS AND METHODS:

All the published names in the group from the study area and adjacent areas were indexed and protologues gathered from various libraries and herbaria.

Herbarium materials from the following herbaria were studied either by procuring on loan or by visiting them:

ASSAM	-	Kanjilal Herbarium, Botanical Survey of India, Eastern Circle, Shillong
BLAT	-	Blatter herbarium, St. Xavier's College, Bombay
BSD	-	Botanical Survey of India, Northern Circle, Dehra Dun
BSI (Gangtok)	-	Botanical Survey of India, Sikkim-Himalayan Circle, Gangtok
BSI	-	Botanical Survey of India, Western Circle, Pune
BSJO	-	Botanical Survey of India, Arid Zone Circle, Jodhpur
CAL	-	Central National Herbarium, Botanical Survey of India, Howrah
DD	-	Forest Research Institute, Dehra Dun
LWG	-	National Botanical Research Institute, Lucknow
MH	-	Madras Herbarium, Botanical Survey of India, Southern Circle, Coimbatore
PCM	-	Presidency College Herbarium, Madras

The specimens were collected with care in the field. They were lifted with the substratum in case of terrestrial species and slowly washed in water to remove the mud. The washed specimens which retain vegetative organs were given field numbers. A portion of the material was pickled using 50% alcohol and 5% glycerin or 50% alcohol following Taylor (1977b). Alcohol content was increased to 55% in the case of aquatic plants. The advantage in this process being, the material never became brittle, thus facilitating dissection. Specimens were dried for the herbarium keeping them in between blotters, after poisoning with absolute alcohol saturated with mercuric chloride. The dried specimens were mounted on standard herbarium sheets, properly labelled, identified and incorporated in the Madras Herbarium (MH). The details which could not be observed in dried specimens were noted in the field and transferred to herbarium sheets. These details include date of collection, place of collection, altitude, habitat, associated plants, frequency, distribution, flower colour etc.

The specimens received on loan as well as liquid preserved specimens were critically studied. A large number of illustrations were drawn, using translucent light in Olympus stereo microscope. The characters observed were tested with the characters mentioned in the literature. Circumscription of the taxa was delimited with the newly observed characters.

Protologues and type specimens were studied for all the names except for those mentioned otherwise. The type materials deposited in Indian herbaria were studied in original and those in the foreign herbaria studied either in the form of microfiche or photographs (cibachrome or black & white). All the names were typified and nomenclature brought up to date following the current International Code of Botanical Nomenclature (Voss 1983).

Detailed descriptions, which clearly define the circumscription of various taxa, have been provided based on ample materials both pickled and dried. The special terminologies used in the descriptions were mostly adopted from Taylor (1964, 1977a) and Lawrence (1951). The taxa which could not be accommodated in known entities were described as new taxa. All the specimens studied for this work have been critically annotated and their correct identity and nomenclature established. The illustrations are selectively reproduced from copious drawings made during the study. These illustrations were drawn using Rotring pen; scale is given for all the figures. The dichotomous keys have been prepared on the basis of characters which are most reliable for identification.

5. PLAN OF THE THESIS:

The treatment of the family includes the original citation of the family name, description, number of genera in the World and India, distribution of genera, number of species in each genus, and key to the Indian genera.

The genera are arranged alphabetically, and each genus contains the correct name and relevant synonyms with original citations and reference to important works and monographs, indication of type species, description, distribution, number of species for the World and for India, chromosome number(s) and pollen morphology. Under each genus the species are arranged alphabetically; the excluded and imperfectly known species are treated at the end.

For each species the correct name is given in bold face. This is followed by all synonyms, in chronological order which are single-underlined. For the correct name and synonyms references to original publications, important floras, monographs/revisions and publications of taxonomic and distributional importance are given, along with the 'type' details wherever available. Acronym of the herbarium, where the type is deposited is given in paranthesis and if the type specimen is examined for this work, it is indicated by the exclamatory mark (!). When photograph or microfiche is seen, it is clearly mentioned. The local names, if any, are mentioned next. An elaborate description of species is given, followed by flowering and fruiting season, ecology, distribution, chromosome number, pollen and notes in separate paragraphs. 'Notes' under each species contain important morphological variations, the taxonomic position and diagnostic characters of the species, nomenclatural aspects, etc. The specimens examined

and studied are listed statewise and for each state in chronological order of collection with locality, name of collector, collection number and acronyms of herbaria where they are deposited. The names of states are arranged alphabetically. Reference to type photographs, wherever available is given at the end of original citation; reference to illustrations and photographs is given at the end of description, and reference to maps given at the end of distribution.

The bibliography section includes references given in the text as well as general references useful for this study. The index to collectors provides collectors' names arranged alphabetically with their collection number/Accession number, the corresponding species number in the text and the acronyms of herbaria where the collections are deposited.

An Index to names of genera, species and infra-specific taxa is given at the end. The correct names are given in bold face and synonyms single underlined.

6. OBSERVATIONS AND DISCUSSIONS:

6.1. Morphology and variations:

The members of the family Lentibulariaceae grow mostly in moist or aquatic situations. Their habit is modified to a great extent, displaying only the elegant inflorescence above the substratum as in the case of Utricularia. The

vegetative organs in Utricularia are usually concealed underwater or sunk in mud or moss and ^{due} to the variation in habitats, their morphology show noticeable variations.

6.1.1. Roots/rhizoids: Roots are tubular and numerous in Pinguicula. True roots are absent in Utricularia, but root-like organs called rhizoids are present. Function of rhizoids is to provide anchorage. They can easily be identified by the absence of foliar organs on them. In aquatic species rhizoids are usually absent. But in U. exoleta R. Br. the rhizoids are well developed with thick base and botryform branches as in U. australis R. Br. U. aurea Lour. rarely develops long, fusiform, float-like rhizoids at scape base. In terrestrial and epiphytic (partial) species they are well developed at scape base and often at axils of first and second scales in the former. Branches are usually simple and papillose.

6.1.2. Stem/stolon: Stem is short and rhizomatous in Pinguicula alpina L. True stem is absent in Utricularia and is substituted by stolons. In aquatic species they are submerged or floating in water and sometimes grow even up to 1 m long. U. exoleta shows circinate vernation and U. minor develops turions or winterbuds, when growing in cold climates. In terrestrial species the stolons are filiform, profusely branched and confined to mud. All epiphytic species have stolons except U. furcellata.

U. brachiata develops tubers at base. As stolons are easily detachable, many collections, especially terrestrials are without foliar organs and traps.

6.1.3. Leaf/Foliar organs: Leaves in Pinguicula alpina are rosulate. Petiole is decurrent with a membranous wing. Upper surface of the lamina is viscid-glandular. The margin is involute, and the lamina rolls in further when prey sticks to the surface and uncurl only after the 'digestion' is complete.

Though true leaves are absent in Utricularia, there are foliar organs, the equivalent of green parts in most species. Shape, size and pattern of nerves of these foliar organs are useful in broad taxonomic groupings (Fig. 1). The following types of foliar organs are noticed:

Dissected foliar organs: These are present in aquatic species, and the much dissected foliar organs were misinterpreted as roots by eighteenth century botanists. The number of primary foliar organs arranged semiverticillately, range from 3-5 (-6) in U. aurea and U. stellaris and occasionally with two stipule-like, dissected, auricular structures at base. The primary foliar organs are two in U. australis. Foliar organs divide just above the base and they further divide once or twice in U. exoleta. U. minor has polymorphic foliar organs, which are palmately divided. They vary in length and breadth. Traps are absent on short

and broad foliar organs. In U. minor the apical foliar organs crowd together to form winterbuds or turions to overcome the winter season.

Peltate foliar organs: These are characteristic of U. pubescens with which we can identify the species.

One-nerved foliar organs: 1-nerved foliar organs are of two kinds: 1. Linear as in U. arenaria, U. baouleen-sis, U. bifida, U. hirta, U. minutissima, U. polygaloides, U. recta, U. reticulata, U. scandens and U. subulata; and 2. spatulate as in U. caerulea and U. roseopurpurea.

Three- or more-nerved foliar organs: Foliar organs of certain species are 3-nerved; often these nerves branch further. These species are either widespread as in U. uliginosa, or restricted to the peninsular India and Ceylon as in U. albocaerulea, U. cecilii, U. graminifolia, U. lazulina, U. malabarica, U. nayaraii, U. praeterita, U. purpurascens, U. smithiana, and U. wightiana.

The peltate, 1-nerved or 3-nerved foliar organs as mentioned above are present in terrestrial species. These foliar organs are present at scape base and on stolons with traps attached to them.

Orbicular or reniform foliar organs: This type of foliar organs is characteristic of epiphytic species.

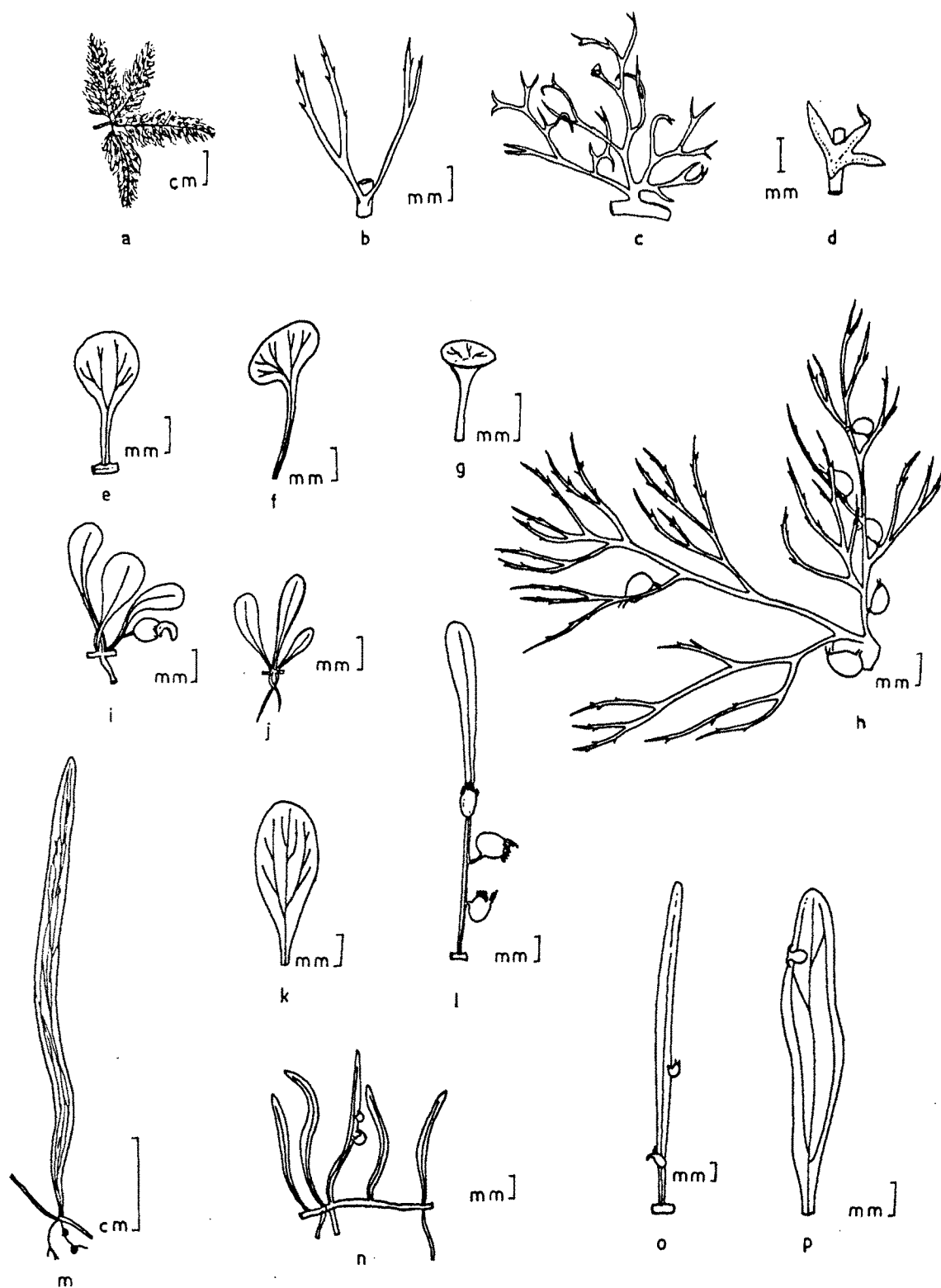


Fig. 1. Foliar organs: a. *Utricularia aurea*; b. *U. exoleta*; c, d. *U. minor*; e. *U. striatula*; f. *U. brachiata*; g. *U. pubescens*; h. *U. australis*; i. *U. roseopurpurea*; j. *U. caerulea*; k. *U. albocaerulea*; l. *U. hirta*; m. *U. nayarlii*; n. *U. scandens*; o. *U. reticulata*; p. *U. graminifolia*.

The foliar organs are rosulate at scape base and scattered on stolons except in U. furcellata, where the stolons are absent. The pseudopetiole terminates in an expanded reniform structure in U. brachiata, or orbicular structure in U. striatula, U. furcellata, U. kumaonensis and U. multicaulis. Traps are absent on these foliar organs. The expanded portion shows dichotomous venation which is quite significant from the evolutionary point of view (Subramanyam & Yoganarasimhan 1979).

KEY TO THE SPECIES (INDIVIDUAL OR ASSEMBLAGE) OF UTRICULARIA
BASED ON FOLIAR ORGANS

1. Dissected:

2. Polymorphic U. minor

2. Monomorphic:

3. 3-5 per node. U. aurea &

U. stellaris

3. 1-2 per node U. australis &

U. exoleta

1. Entire:

4. Orbicular to reniform:

5. Reniform U. brachiata

5. Orbicular to suborbicular:

6. Present at scape base only . . U. furcellata

6. Present at scape base and on
stolons U. kumaonensis,
U. multicaulis &
U. striatula

4. Linear, spatulate or peltate:

7. Peltate U. pubescens

7. Linear or spatulate:

8. 1-nerved:

9. Spatulate U. caerulea &
U. roseopurpurea9. Linear U. arenaria,
U. baouleensis,
U. bifida,
U. hirta,
U. minutissima,
U. polygaloides,
U. recta,
U. reticulata,
U. scandens &
U. subulata8. 3- or more nerved U. albocaerulea,
U. cecilii,
U. graminifolia,
U. lazulina,
U. malabarica,
U. nayarii,
U. praeterita,
U. purpurascens,
U. smithiana,
U. uliginosa &
U. wightiana

6.1.4. Traps: The traps are insect capturing organs in Utricularia. They have been called urceoli, ampullae, vesiculae, utriculae, pitchers, bladders or traps (Lloyd 1942). They are attached to vegetative organs (rhizoids,

stolons and foliar organs) except in epiphytes where they are absent on foliar organs. These stalked structures have an orifice called mouth. The position of mouth to the point of attachment of stalk is important in broad classification. The trap opens inwards by a door. Bifid or quadrifid digestive glands are present within (Subramanyam & Abraham 1967). The appendages of traps also vary to a large extent, providing diagnostic characters (Fig. 2a-m). On the basis of position of mouth the traps of Indian *Utricularias* can be grouped as follows:

Mouth basal: This kind of trap, where the mouth is situated near the stalk is present only in terrestrial species. The appendages are 2 and simple as in *U. graminifolia*, or branched as in *U. baouleensis*. Sometimes a columnar structure develops on the stalks of *U. scandens* and *U. recta*.

Mouth terminal: Traps of this kind have mouth at the opposite side of the point where the stalk is attached. This type is found in terrestrial species only. The appendages are of numerous rows of comb-like gland-tipped hairs as in *U. arenaria* and *U. pubescens*, or a beak-like or sickle shaped structure as in *U. caerulea* and *U. roseopurpurea*.

Mouth lateral: All the aquatic and epiphytic species including the few terrestrials have lateral mouth. In aquatics (eg. *U. aurea*) the mouth is oblique and appendages

are subulate. The number of appendages ranges from 2- to many, or altogether absent. Epiphytes (eg. U. striatula) have the expanded upper lip with radiating gland-tipped hairs. Terrestrial species have two branched appendages as in U. subulata, or 3 connate processes (2-winged laterals and 1 subulate dorsal) as in U. hirta and U. minutissima.

The structure of traps is well explained by Lloyd (1942). Many papers on the function and mechanism of traps have appeared including the works from India by Ekambaram (1916, 1918, 1926).

KEY TO THE SPECIES (INDIVIDUAL OR ASSEMBLAGE)

BASED ON TRAP

CHARACTERS

1. Mouth lateral:

2. Upper lip expanded with radiating glandular

hairs	<u>U. brachiata</u> ,
	<u>U. furcellata</u> ,
	<u>U. kumaonensis</u> ,
	<u>U. multicaulis</u> &
	<u>U. striatula</u>

2. Upper lip not expanded:

3. Mouth oblique	<u>U. aurea</u> ,
	<u>U. australis</u> ,
	<u>U. exoleta</u> ,
	<u>U. minor</u> &
	<u>U. stellaris</u>

3. Mouth circular:

- 4. Appendages 2, branched U. subulata
- 4. Appendages 3 of connate processes. U. hirta &
U. minutissima
- 1. Mouth terminal or basal:
 - 5. Mouth terminal:
 - 6. Appendages a beak-like structure. U. caerulea &
U. roseopurpurea
 - 6. Appendages of comb-like radiating
hairs U. arenaria &
U. pubescens
 - 5. Mouth basal:
 - 7. Appendages branched U. baouleensis
 - 7. Appendages simple:
 - 8. Columnar growth present on stalk. U. recta p.p.
U. scandens p.p.
 - 8. Columnar growth absent on stalk. U. albocaerulea
U. bifida,
U. cecilii,
U. graminifolia,
U. lazulina,
U. malabarica,
U. nayaraii,
U. polygaloides,
U. praeterita,
U. purpurascens,
U. recta p.p.,
U. reticulata,
U. scandens p.p.,
U. smithiana,
U. uliginosa &
U. wightiana

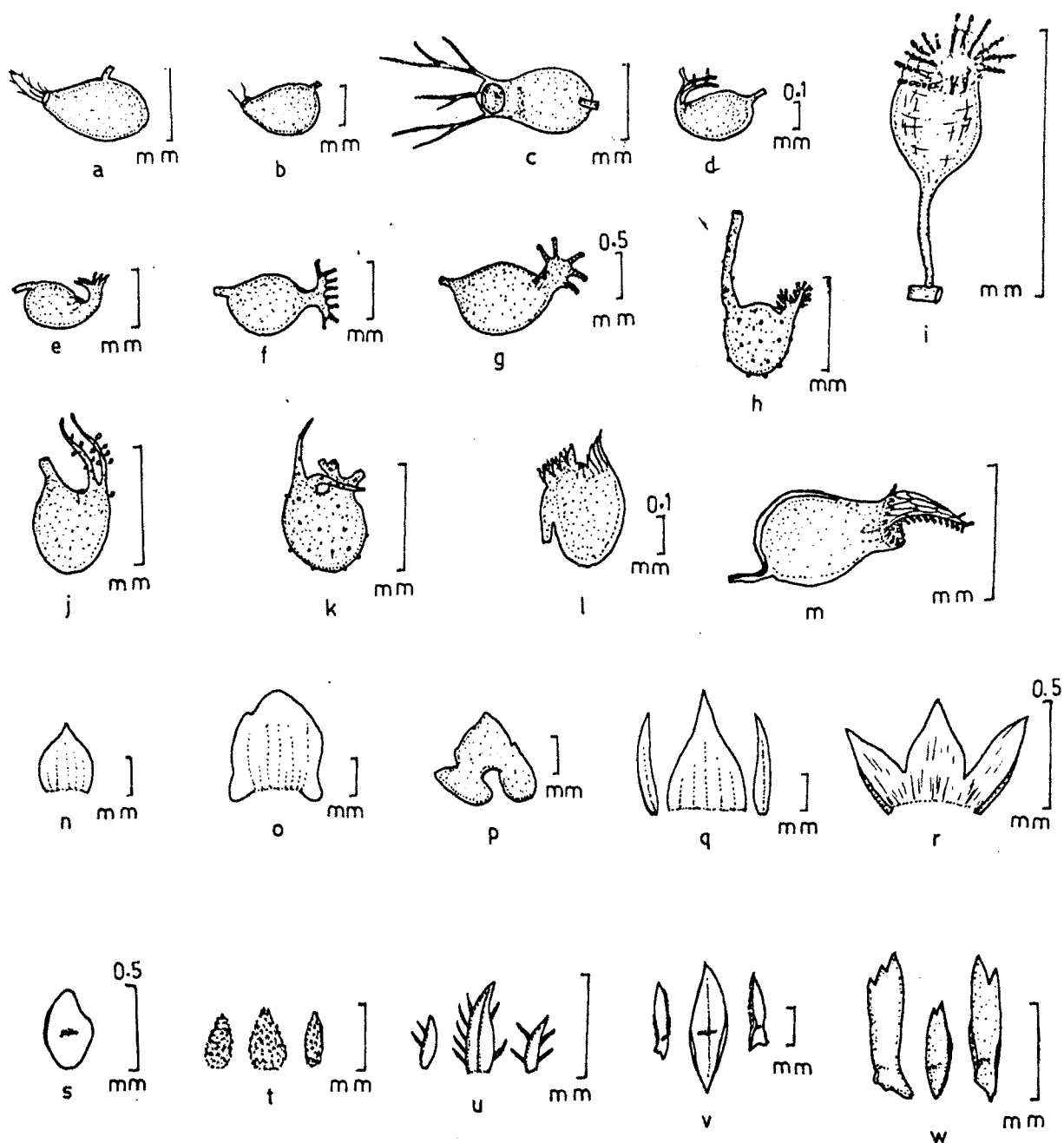


Fig. 2. Traps (a-m): a. *Utricularia stellaris*; b. *U. australis*; c. *U. exoleta*; d. *U. subulata*; e. *U. brachiata*; f. *U. furcellata*; g. *U. kumaonensis*; h. *U. striatula*; i. *U. pubescens*; j. *U. albocaerulea*; k. *U. scandens*; l. *U. hirta*; m. *U. caerulea*. Bracts & bracteoles (n-w): n. *U. aurea*; o. *U. australis*; p. *U. minor*; q. *U. cecillii*; r. *U. minutissima*; s. *U. subulata*; t. *U. pubescens*; u. *U. hirta*; v. *U. roseopurpurea*; w. *U. kumaonensis*.

6.1.5. Inflorescence: Single-flowered scapes (1-5) occur in Pinguicula alpina. In Utricularia spp. racemes are 1- many-flowered. The racemes emerge out of water in aquatic species. They are held up by spongy floats in U. stellaris, and rarely by inflated rhizoids in U. aurea. In terrestrial species the inflorescence is either twining as in U. baouleensis, U. reticulata and U. scandens, or erect as in rest of the species. In U. hirta the inflorescence is hairy and in U. pubescens papillose.

6.1.6. Scale, bract, bracteole and pedicel:

Scales are generally present on peduncles. They are absent in aquatic species like U. stellaris. In U. aurea the basifixed scales develop rarely. In U. australis and U. minor scales are auriculate. The scales are usually absent in partial epiphytes. Terrestrial species invariably have scales which are basifixed in majority of the species, or medifixed as in U. caerulea, U. roseopurpurea, U. pubescens and U. subulata.

Bracts are usually similar to scales in their shape and their position of attachment. They render important characters for identification. Bracteoles are present on either side of the bract, basifixed when the bract is basifixed, and medifixed or basisolute when the bract is medifixed (Fig. 2n-u). The bracteoles are equal to or longer than bracts in epiphytic species and terrestrial

species with medifixed bracts, and are subulate in terrestrial species with basifixed bracts; in U. hirta and U. minutissima they are much broader.

Pedicels are terete in aquatics, and distally thickened and recurved in U. aurea and U. stellaris. Epiphytes have terete pedicels which are often thick and recurved as in U. multicaulis. All the terrestrials which have basifixed bracts show flattened and winged pedicels except in U. hirta and U. minutissima where they are terete. Species like U. albocaerulea, U. baouleensis, U. bifida, U. malabarica and U. purpurascens have recurved fruiting pedicels. U. caerulea and U. roseopurpurea often show recurved fruiting pedicels.

6.1.7. Flowers:

6.1.7.1. Calyx: Calyx is 2-lobed and accrescent in Utricularia and 5-lobed (upper lip 3-lobed and lower lip 2-lobed) in Pinguicula. In aquatic Utricularias calyx-lobes are equal or subequal; they are reflexed in U. aurea. In epiphytic species they are highly unequal and papillose. Calyx-lobes are hood-like and papillose in U. caerulea and U. roseopurpurea, hairy in U. hirta, and prominently nerved in U. subulata. Calyx-lobes are obtuse in U. bifida. Fruiting calyx-lobes are unequal in U. nayarii and U. recta.

6.1.7.2. Corolla: Corolla in Pinguicula alpina is cream-coloured; upper lip 2-lobed and lower 3-lobed, and spur

distinct and blunt at apex. In Utricularia the corolla is 2-lipped; colour of corolla varies from white, cream-coloured, yellow, blue, pink, purple, mauve to violet; upper lip varies in size and shape. Lower lip is 3-6-lobed in epiphytic species, and gibbous at base in terrestrial and aquatic species. A few species show characteristic spur, which is sickle-shaped in U. purpurascens, long and straight descending in U. malabarica, horizontal in U. hirta, U. minutissima and U. caerulea, and saccate in U. minor. Presence of cylindrical gland-tipped hairs on the spur of U. aurea, globose gland-tipped hairs on the spur of U. stellaris, and ligule^t on lower lip in U. keralensis are quite diagnostic.

6.1.7.3. Stamens: Stamens are two, both in Pinguicula and Utricularia. They are attached near to the base of upper lip, and the filaments are flat and often twisted. Anther thecae are distinct in many species, but confluent or subdistinct in epiphytes.

6.1.7.4. Pistil: Pistil is equal to stamens in length. Ovary is globose to oblongoid, oblique in epiphytic species; placentation is free central or axile. Style is usually thick, flattened and much reduced. Stigma is 2-lipped, the upper usually reduced or represented by a small, subulate or dentate structure, and the lower orbicular to semiorbicular, often recurved and ciliate.

6.1.8. Capsule: The fruits render important characters in the broad classification of species. Capsule is ellipsoid to oblongoid and 2-valved in Pinguicula alpina. It is globose and circumscissile in U. aurea, U. minor and U. stellaris, and 2-valved in U. exoleta. Capsule is beaked in U. aurea. In epiphytes the capsule is oblique, partly attached to upper calyx-lobe and dehiscence by a ventral, vertical slit. The capsule of U. kumaonensis is oblongoid and longer than calyx-lobe when compared with U. multicaulis, where it is subglobose and shorter than calyx-lobe. Surface of the capsule is papillose in U. caerulea and U. roseopurpurea. The capsule opens by a ventral pore in U. subulata. In other terrestrial species the capsule wall may be thickened along the dehiscent margin or uniform throughout. These characters are useful in segregating certain species, which were earlier confused as in the case of U. graminifolia, U. smithiana, U. wightiana and U. uliginosa (Fig. 3a-h).

6.1.8.1. Seed: Seeds are numerous, small, cylindrical to oblongoid and slightly tuberculate in Pinguicula alpina. Seed characters of Utricularia show greater variations as recorded by Abraham & Subramanyam (1965) and Robins & Subramanyam (1980). (Fig. 3i-v). They can be broadly classified as follows:

Winged seeds: These are characteristic of aquatic species. They are lenticular, broadly corky-winged in

U. exoleta, and prismatic, 5-7-angled and slightly winged in U. aurea, U. minor and U. stellaris.

Seeds without wings and appendages: These are characteristic of terrestrial species. Testa is tuberculate or papillose in U. roseopurpurea; scrobiculate with more or less isodiametric or slightly elongated cells in U. keralensis, U. nayarii, U. smithiana, U. uliginosa and U. wightiana; and testa cells more or less isodiametric in U. hirta and U. minutissima. Testa cells are much elongated and compactly arranged in U. albocaerulea, U. praeterrita and U. purpurascens. Testa has intercellular spaces in U. cecilii. Testa cells are finely striated within in U. baouleensis, U. bifida, U. polygaloides and U. reticulata, and verrucose in U. lazulina.

Appendaged seeds: Much complicated seed structure is seen among epiphytic species. The seeds are glochidiate in U. striatula and U. furcellata, but the hilum is terminal in U. striatula and lateral in U. furcellata. U. multicaulis has echinate seeds with long appendages on one end of the seed only. U. brachiata and U. kumaonensis have seeds with appendages on both ends, but the testa is reticulate and smooth in the former, and echinate in the latter. The glochidia or appendages prevent the seeds washing down to unfavourable substratum.

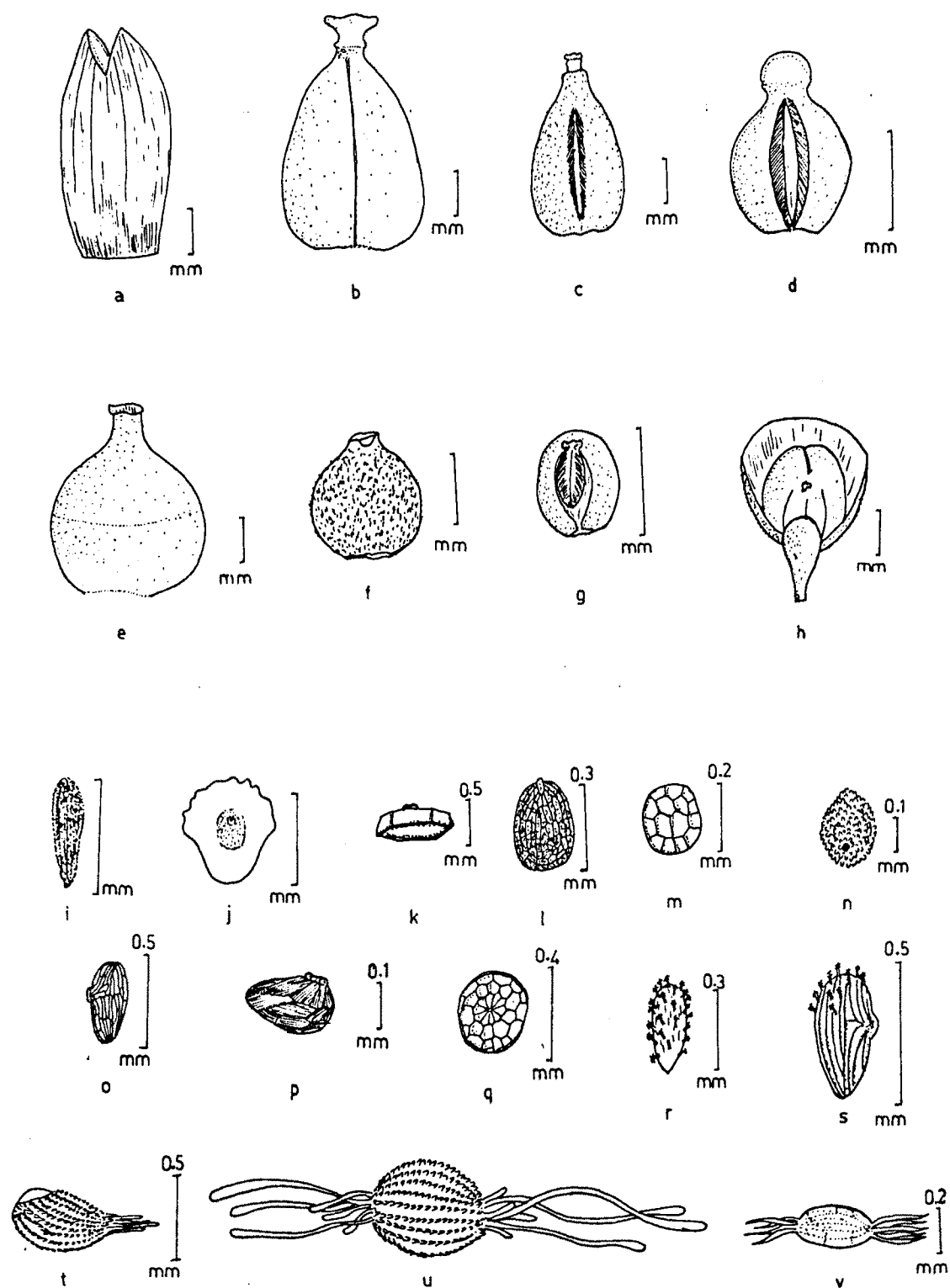


Fig. 3. Capsules (a-h): a. *Pinguicula alpina*; b. *Utricularia smithiana*; c. *U. graminifolia*, d. *U. hirta*; e. *U. stellaris*; f. *U. caerulea*; g. *U. subulata*; h. *U. striatula*. Seeds (i-v): i. *Pinguicula alpina*; j. *Utricularia exoleta*; k. *U. stellaris*; l. *U. lazulina*; m. *U. hirta*; n. *U. roseopurpurea*; o. *U. praeterita*; p. *U. reticulata*; q. *U. uliginosa*; r. *U. striatula*; s. *U. furcellata*; t. *U. multicaulis*; u. *U. kumaonensis*; v. *U. brachiata*.

KEY TO THE SPECIES (INDIVIDUAL OR ASSEMBLAGE) OF
URICULARIA BASED ON SEED CHARACTERS

1. Appendages present:
 2. Appendages glochidiate:
 3. Hilum terminal; seeds radially attached
 to placentum U. striatula
 3. Hilum lateral; seeds tangentially attached
 to placentum U. furcellata
 2. Appendages comose:
 4. Appendages on both ends of seed:
 5. Testa echinate U. kumaonensis
 5. Testa smooth, reticulate U. brachiata
 4. Appendages on one end of seed
 only U. multicaulis
1. Appendages absent:
 6. Seeds winged:
 7. Seeds lenticular, broadly corky winged. U. exoleta
 7. Seeds prismatic, slightly winged. U. aurea,
U. minor &
U. stellaris
 6. Seeds not winged:
 8. Testa striated within U. baouleensis,
U. bifida,
U. polygaloides &
U. reticulata
 8. Testa not striated within:
 9. Testa tubular or papillose. U. roseopurpurea
 9. Testa reticulate and scrobiculate:

10. Testa cells verrucose U. lazulina
10. Testa cells not verrucose:
11. Testa with intercellular space . . . U. cecilii
11. Testa without intercellular space.. U. albocaerulea,
 U. arenaria,
 U. caerulea
U. graminifolia,
 U. hirta,
 U. keralensis,
 U. malabarica,
U. minutissima,
 U. nayaraii,
 U. praeterita,
 U. pubescens,
U. purpurascens,
 U. recta,
 U. scandens,
 U. smithiana,
 U. subulata,
U. uliginosa &
 U. wightiana

6.2. Ecology: Pinguicula alpina L. the only species in the genus distributed in India is found mostly above 1,500 m altitude up to the snow covered regions along grassy slopes and streams in Himalayas.

Based on the habitats, the Indian species of Utricularia can be divided into aquatic, terrestrial and epiphytic (partial). Aquatics are present in fresh water ponds, lakes, ditches and rice fields from sea-level to higher altitudes. U. aurea occurring in ponds near sea-shore

produces somewhat thick stolons and foliar organs. U. exoleta develops circinate vernation with the reduction in branching of foliar organs, when occurring in cold climates. U. minor develops turions at the apices of stolons in winter season.

Partial epiphytes either grow on moss-covered tree trunks or on dripping vertical faces of rocks, where direct sunlight seldom reaches. The appendages on seeds prevent seeds from being washed down to unfavourable substratum. These species (U. brachiata, U. furcellata, U. kumaonensis, U. multicaulis and U. striatula) grow in higher altitudes.

Different terrestrials show their individual affinity towards the substratum. U. albocaerulea, U. cecilii, U. lazulina, U. malabarica and U. praeterita show affinity to laterite rocks. Their substratum is normally wet in monsoon season and completely dry during other seasons. They sprout up immediately after the first showers. The distribution of terrestrial species show different altitudinal ranges. U. nayaraii, U. roseopurpurea, U. smithiana and U. wightiana are restricted to the altitudes above 1800 m and are mostly seen and collected on dripping rocks and along streamlets in grasslands. U. reticulata is mostly seen in rice fields with their inflorescence twining to paddy culms or twining among themselves. U. polygaloides grows in wet sea-shores, wastelands and sandy places. U. graminifolia and U. uliginosa grow along marshy places in

hills and rarely in low altitudes, and as they grow along perennial water sources, flowers are seen throughout the year with the peak soon after monsoon. Due to the variations in the nature of raceme, foliar organs and flowers, which are greatly influenced by the substrata, a large number of species were recognised earlier. U. scandens is distributed from plains to high altitudes up to 2,500 m; U. bifida and U. caerulea grow in varied habitats from sea-level to high altitudes. U. arenaria, U. hirta, U. minutissima, U. pubescens and U. subulata grow in sandy soil.

6.2.1. Phytogeography: Flora of India contains many plants of distributional interest due to its geological history. The peninsular India harbours many species of plants that are common to Africa, Madagascar, Sri Lanka and Malesia, which together with Australia once constituted the great Gondwanaland. The Himalayan range acts as a convenient pathway for the migration of temperate floras to India. In this family, the area has some circumboreal species like U. minor and Pinguicula alpina. The distribution pattern as shown below will highlight the phytogeographical importance of Indian region:

Species common to India and Africa:

1. U. arenaria A. DC.
2. U. australis R. Br.

3. U. baouleensis A. Chev.
4. U. exoleta R. Br.
5. U. pubescens Smith
6. U. scandens Benj.
7. U. stellaris L.f.
8. U. striatula Smith
9. U. subulata L. (also distributed in America).

Species common to India and Malesia:

1. U. aurea Lour.
2. U. australis R. Br.
3. U. baouleensis A. Chev.
4. U. bifida L.
5. U. caerulea L.
6. U. exoleta R. Br.
7. U. hirta Klein ex Link
8. U. minor L.
9. U. minutissima Vahl
10. U. scandens Benj.
11. U. striatula Smith
12. U. subulata L.
13. U. uliginosa Vahl

Species common to India and Sri Lanka

1. U. aurea Lour.
2. U. bifida L.
3. U. caerulea L.

4. U. exoleta R. Br.
5. U. graminifolia Vahl
6. U. minutissima Vahl
7. U. polygaloides Edgew.
8. U. reticulata Smith
9. U. roseopurpurea Stapf ex Gamble
10. U. stellaris L.f.
11. U. striatula Smith
12. U. uliginosa Vahl

Species common to India and Europe

1. Pinguicula alpina L.
2. Utricularia minor L.
3. U. australis R. Br.

It was observed that the species common to India, Africa, and Malesia, and to India and Malesia have single-nerved foliar organs except U. uliginosa which has 3-nerved foliar organs. The species endemic to peninsular India have 3-nerved foliar organs. This phytogeographical evidence is in accordance with the theory on continental drift and suggests that the 3-nerved foliar organs are recent in origin, and might have evolved from 1-nerved foliar organs.

6.2.1.1. Endemism: There are no species endemic to India in the genus Pinguicula. But in Utricularia, out of 35

species present in India, 19 species are endemic to their geographical areas. They can be divided as follows:

Species endemic to Western Ghats of India:

1. U. albocaerulea Dalzell
2. U. cecilii Taylor
3. U. keralensis M.K. Janarthanam
4. U. lazulina Taylor
5. U. malabarica M.K. Janarthanam & A.N. Henry
6. U. nayarii M.K. Janarthanam & A.N. Henry
7. U. praeterita Taylor
8. U. purpurascens Graham
9. U. smithiana Wight
10. U. wightiana M.K. Janarthanam

Species restricted to Peninsular India and Sri Lanka:

11. U. graminifolia Vahl
12. U. polygaloides Edgew.
13. U. reticulata Smith
14. U. roseopurpurea Stapf ex Gamble

Species endemic to Himalayas and Meghalaya:

15. U. brachiata Oliver
16. U. furcellata Oliver
17. U. kumaonensis Oliver
18. U. multicaulis Oliver
19. U. recta M.K. Janarthanam

The above species are considered neoendemics as they have taxonomically interrelated species complements and occur in the same or adjacent areas as per the definition given by Nayar (1980). Many species are endemic to the peaks of W. Ghats which are isolated and comparable to islands (Subramanyam & Nayar 1974).

Few species are endemic to the Himalayas. According to Nayar (1977) the endemic nature of Himalayan flora is that of the Himalayas as a whole and not of any political boundary. According to him though the Himalayan range acted as a geographical barrier it also functioned as a crucible for the evolution of new species complexes in the sanctuaries offered by the Himalayan mountain system. The closely related endemic species like U. brachiata, U. furcellata, U. kumaonensis and U. multicaulis might have stemmed from a common ancestor like U. striatula Smith, and U. recta, the other endemic species of the region ($n = 7$) from U. scandens Benj. ($n = 6$) due to ploidy.

6.3. Chromosomes: An important work on the Chromosomes of Indian Utricularias is by Subramanyam & Kamble (1968) dealing with seven species: U. aurea ($n = 21$), U. baouleensis ($n = 10$), U. caerulea ($n = 20$), U. inflexa Forssk. var. stellaris (L.f.) Taylor (= U. stellaris L.f.) ($n = 21$), U. minutissima ($n = 8$), U. scandens ($n = 6, 7$) and U. stricticaulis (= U. polygaloides Edgew.) ($n = 7$). The report for the very rare U. baouleensis ($n = 10$) perhaps needs revision as the

identity of the plant collected for the study from Meghalaya is doubtful. Further, two numbers have also been reported for U. scandens: $n = 6$ based on the collection from Tamil Nadu and $n = 7$ for the plant from Meghalaya. It has been concluded that they were only cytotypes of the same species. The Meghalaya collection has however been proved to be only U. recta [previously known as U. scandens Benj var. firmula (Oliver) Subramanyam & Banerjee]. Virendra Kumar & Subramaniam (1986) in their compilation lists numbers of nine species for the Indian region; these include Pinguicula alpina ($2n = 32$).

The earlier work of Siddiqui (1959) also reports $n = 21$ for U. aurea. The first chromosome report on Indian Utricularias was by Kausik (1938). He mentions $n = 20$ for U. caerulea. As there is no specimen to confirm its identity and as he describes the specimen as "entire surface of the plant is studded over with glandular hairs" its identity becomes doubtful. For U. minor the chromosome numbers recorded are $2n = 34-40, 36, \text{ or } 40$ (Virendra Kumar & Subramaniam l.c.). Kondo (1972) has reported $2n = 36$ for U. racemosa Wall. (= U. caerulea L.), and $n = 15$ for U. subulata which is being reported in this work as a new record to India. Thus 'n' number = 6, 7, 8, 10, 15, 16, 17, 18, 20 and 21 are recorded for the family. To construct a meaningful cytoevolution of the family all the members have to be examined with their voucher materials correctly identified and deposited in standard herbaria.

6.4. Pollen: The pollen records of the extant Lentibulariaceae date back to Upper Miocene (Muller 1981). The pollen of the genus Utricularia is eurypalynic. Huynh (1968) has worked on palynotaxonomy according to Kamienski's (1893) system and shifted a few species from one section to another based on palynological evidence. The general pollen structure was described by Erdtman (1952) as colpoidate. Pollen materials of Indian Utricularias were worked out along with their embryology by earlier workers and they were described as porate (Shivaramiah 1964a; Siddiqui 1965b; Maqbool Begum 1965), or as possessing 3-21 furrows (Khan 1954; Khan et al. 1964 ; Farooq 1964, 1965; Farooq & Siddiqui 1964). The major work was done by Thanikaimoni (1966) for 22 Indian species; he described them as colporate.

Thanikaimoni (l.c.) divided Indian Utricularias into 3 groups based on palynological characters which are further supported by their distinct habitats and seeds.

In the first group he included aquatic species, which have winged seeds. The pollen grains are 11-28-colporate, ectoaperture elongated, endoapertures laterally united to form a continuous transverse furrow. Group two contains all terrestrials which have scrobiculate, reticulate seeds with 3-5-colporate, ectoaperture elongated (14-33 μ long), endoaperture elliptic pollen. The third group is of partial epiphytes and which have glochidiate or comose seeds. The pollen grains in them are 3-4-colporate, ectoaperture short (5-8 μ long), endoaperture elliptic.

Erdtman (1952) has remarked that pollen grains of Utricularia resemble that of Polygala. Thanikaimoni (l.c.) evidenced that only the pollen of aquatic species resemble that of Polygala. However, Thanikaimoni (l.c.) declares that pollen morphology of Lentibulariaceae does not contradict the view that the family shows affinity to Scrophulariaceae, possibly also to Primulaceae.

6.5. Characters used in the key:

In earlier floras the characters used in the keys were much variable and inconsistent, resulting in inaccurate identification of specimens in herbaria. The characters used in this work however are based on intensive and extensive study of several hundreds of specimens both in the field and herbaria which have been tested and proved to be consistent.

To distinguish genera the characters like number of calyx-lobes, presence or absence of true roots, traps and viscid glands on leaves are used. The aquatic species of Utricularia can be clearly distinguished by their dissected foliar organs, and winged seeds. Whereas the terrestrial and epiphytic species have entire foliar organs and non-winged seeds. Among the aquatic species the number of foliar segments is characteristic for broad grouping. The lenticular seeds in U. exoleta, floats, along the globose glands on corolla in U. stellaris, cylindrical glands

in U. aurea, and polymorphic leaves in U. minor are quite diagnostic.

Further, the epiphytic species can be differentiated from the rest by their orbicular to reniform foliar organs with dichotomously divided nerves, highly unequal calyx lobes and appendaged seeds. Based on seed character alone it is possible to identify them up to the species level, though there are many supporting characters. Among terrestrials, for broad groupings, characters like position of attachment of bracts can be used. For further groupings the number of nerves (1- or more-nerved) on foliar organs, position of mouth in traps (basal, lateral or terminal), appendages etc. have been used. Presence or absence of thickening along the dehiscent margin of capsule, position of hilum, structure of testa and striations within testa cells are also useful in keying out various species. Table 1 shows the characters which can individually lead to the identification of species:

TABLE 1: Individual characters leading to the identification of species.

	Foliar organs	Traps	Flow- ers	Seeds	Veg. parts only	Infl. only incl. fr.
U. albocaerulea						x
U. arenaria			x		x	x
U. aurea			x			x
U. australis	x		x		x	x
U. baouleensis		x	x	x	x	x
U. bifida			x	x		x
U. brachiata	x			x	x	x
U. caerulea			x	x		x
U. cecillii				x		x
U. exoleta	x		x	x	x	x
U. furcellata	x		x	x	x	x
U. graminifolia						x
U. hirta			x			x
U. keralensis			x	x		x
U. kumaonensis		x		x		x
U. lazulina			x	x		x
U. malabarica			x			x
U. minor	x		x		x	x
U. minutissima			x			x
U. multicaulis				x		x
U. nayarii			x			x
U. polygaloides			x	x		x
U. praeterita				x		x
U. pubescens	x		x		x	x
U. purpurascens			x			x
U. recta						x
U. reticulata			x	x		x
U. roseopurpurea			x	x		x
U. scandens						x
U. smithiana						x
U. stellaris			x			x
U. striatula				x		x
U. subulata		x	x			x
U. uliginosa						x
U. wightiana						x

6.6. Taxa recognised in the work:

In total 36 species belonging to 2 genera are recognised for the family Lentibulariaceae in India:

I. *Pinguicula* L.

1. *P. alpina* L.

II. *Utricularia* L.

- | | |
|---|--|
| 1. <i>U. albocaerulea</i> Dalzell | 19. <i>U. minutissima</i> Vahl |
| 2. <i>U. arenaria</i> A. DC. | 20. <i>U. multicaulis</i> Oliver |
| 3. <i>U. aurea</i> Lour. | 21. <i>U. nayarii</i> M.K. Janarthanam & A.N. Henry sp. nov. |
| 4. <i>U. australis</i> R. Br. | 22. <i>U. polygaloides</i> Edgew. |
| 5. <i>U. baouleensis</i> A. Chev. | 23. <i>U. praeterita</i> Taylor |
| 6. <i>U. bifida</i> L. | 24. <i>U. pubescens</i> Smith |
| 7. <i>U. brachiata</i> Oliver | 25. <i>U. purpurascens</i> Graham |
| 8. <i>U. caerulea</i> L. | 26. <i>U. recta</i> M.K. Janarthanam sp. nov. |
| 9. <i>U. cecilii</i> Taylor | 27. <i>U. reticulata</i> Smith |
| 10. <i>U. exoleta</i> R. Br. | 28. <i>U. roseopurpurea</i> Stapf ex Gamble |
| 11. <i>U. furcellata</i> Oliver | 29. <i>U. scandens</i> Benj. |
| 12. <i>U. graminifolia</i> Vahl | 30. <i>U. smithiana</i> Wight |
| 13. <i>U. hirta</i> Klein ex Link | 31. <i>U. stellaris</i> L.f. |
| 14. <i>U. keralensis</i> M.K. Janarthanam sp. nov. | 32. <i>U. striatula</i> Smith |
| 15. <i>U. kumaonensis</i> Oliver | 33. <i>U. subulata</i> L. |
| 16. <i>U. lazulina</i> Taylor | 34. <i>U. uliginosa</i> Vahl |
| 17. <i>U. malabarica</i> M.K. Janarthanam & A.N. Henry sp. nov. | 35. <i>U. wightiana</i> M.K. Janarthanam nom. nov. |
| 18. <i>U. minor</i> L. | |

6.7. Taxonomy and Phylogeny:

Earlier authors (Bentham & Hooker 1876; Hutchinson 1969) considered that the position of the family was intermediate between Primulaceae and Scrophulariaceae. As mentioned under systematic position, the free central placentation brings this family closer to Primulaceae. In epiphytic species, however, an intermediate stage between axile (with septa) and free central placentation is observed - (ie) axile placentation without septa. As the epiphytes are considered to have been evolved at a later period, it necessitates to conclude that this connection (free central to axile) developed later during evolution, as all the terrestrial forms have free central placentation. If the presumption that the intermediate stage between axile placentation and free central placentation occurred during reduction holds good, it can be concluded that at least in this genus, epiphytes have evolved much earlier than the terrestrials. The nature of corolla resembles that of Scrophulariaceae, and several authors have also treated this under the order Personales or Scrophulariales. The pollen structure shows much similarity with Polygalaceae (Erdtman 1952; Huynh 1968; Thanikaimoni 1966).

The genus Utricularia is considered to be of a heterogeneous assemblage (Rafinesque 1837-38; De Candolle 1844; Kamienski 1893; Barnhart 1915; Komiya 1973). Even though distinct groups can be recognised as suggested by the

earlier authors, the 2-lobed calyx and presence of traps are strong enough to bind them under a single genus.

Based on the structure of foliar organs, attachment of bracts, thickening along the dehiscent margin of capsule, ornamentation in testa and supported by phytogeographical evidence, it can be considered that the Indian *Utricularias* have evolved from 4 stocks. Aquatic species are excluded from this, as they are easily distributed by migratory birds and hence of little geographical significance.

The first stock consists of species like *U. furcellata*, *U. kumaonensis*, *U. multicaulis* and *U. brachiata* which are endemic to Himalayas and Meghalaya, and have unequal calyx lobes, appendaged seeds and dichotomously divided nerves in foliar organs. These neoendemics (as evidenced from the geology of Himalayas) might have evolved from *U. striatula* a close relative of them, which has wider distribution ranging from Africa to far east.

The second stock constitutes the *U. subulata* which is pantropical and has single-nerved foliar organs and medifixed bracts. From this the related *U. caerulea* (distributed from India to East and Southeast) and from *U. caerulea*, the allied *U. roseopurpurea* (restricted to Sri Lanka and Peninsular India) might have evolved.

The third stock is *U. baouleensis* distributed from Africa to far east. It has single-nerved foliar organs, striated testa and capsule thickened along the dehiscent

margins. From this, U. bifida, in which the thickening in the capsule is reduced and distributed from India to Southeast might have evolved. Later, U. reticulata and U. polygaloides the allied endemics might have evolved directly from U. baouleensis.

The fourth stock, U. scandens can be considered as a major stock, which has single-nerved foliar organs and capsule thickened along the dehisced margin; its distribution extends from Africa to Southeast Asia. U. uliginosa could have evolved with the reduction of thickening in the capsule and branching of foliar nerves to form basically 3-nerved foliar organs, with the present distribution from India to Malesia. One separate line leads to U. hirta, and then to U. minutissima with the reduction of thickening in the capsule of the latter. These are presently distributed from India to Malesia. U. graminifolia with basically 3-nerved foliar organs probably has evolved directly from U. scandens and is presently distributed in Peninsular India and Sri Lanka. U. recta allied to U. scandens and endemic to Himalayas and Khasi hills might have evolved late in the evolution directly from U. scandens. All the species endemic to peninsular India have basically 3-nerved foliar organs and can be grouped into 2-categories: Species with thickening along the dehisced margin of the capsule, and species without thickening along the dehisced margin of the capsule. These two groups could have evolved from U. graminifolia and U. uliginosa respectively.

Thus a phylogenetic idea as far as the Indian Utricularias are concerned could be arrived at with the available data. However, for a broad and meaningful interpretation additional cytotaxonomic evidences on the genus Utricularia as a whole, are essential.

II SYSTEMATIC TREATMENT

LENTIBULARIACEAE

L.C. Richard in Poiteau & Turpin, Fl. Paris 1: 206. 1808
'Lentibularieae'. - TYPE: Lentibularia Seguiet, nom. illeg.
(= Utricularia L.).

Herbaceous annual or perennial, aquatic, terrestrial or epiphytic (carnivorous nature supplemented by modification of vegetative organs for capture and digestion of animalcules); roots present or absent, sometimes root-like rhizoids present; stems frequently modified into stolons, or absent. Leaves or foliar organs rosulate or scattered on stolons, entire or dissected, rarely polymorphic, often modified into insect capturing organs. Inflorescence a scape or raceme; peduncle glabrous or rarely hairy, simple or rarely branched; scales, if present, basifixed or medifixed; bracts at base of pedicels, basifixed or medifixed; bracteoles two (or absent), usually at base of pedicel, rarely on pedicel. Flowers bisexual, zygomorphic. Calyx regular or 2-5-lobed, or sepals free to the base, persistent and often accrescent. Corolla gamopetalous, 2-lipped, usually violet or yellow with shades of blue, mauve, cream and white; upper lip entire or 2- or more-lobed; lower lip entire, or 2-5-lobed; usually with a raised gibbous base; spur conical, cylindrical, rarely saccate. Stamens 2, inserted at base of corolla; filaments usually short and curved; anther 2-thealous, dehiscent by a common slit. Pistil superior; ovary unilocular, carpels 2, placentation free central or free

basal; ovules usually numerous, sessile, rarely fewer or 2, anatropous; style simple, short; stigma more or less 2-lipped, upper lip smaller than lower or more or less obsolete. Fruit a 1-loculed capsule, 1-many seeded, dehiscent by longitudinal slits or by pores or circumscissile, or rarely indehiscent; placenta variously shaped. Seeds small, variously shaped; endosperm 0; embryo undifferentiated; testa thin or spongy or corky, rarely mucilaginous, testa cells variously ornamented.

Four genera with about 250 species distributed mostly in tropical and temperate regions and extended up to arctic region. Utricularia L. the largest, cosmopolitan genus in the family with about 180 species is mostly distributed in New World and tropical regions of Africa, Asia and Australia with a few in the north temperate zone. Pinguicula L. with about 50 species is mostly centred in the mediterranean region with a few circumboreal species and the distribution of few more extending to Central & South America. Gentlisea St. Hil. having 16 species is confined to tropical South America and Africa. Polypompholyx Lehm. with 2 species is endemic to Australia.

In all, 35 species of Utricularia L. and one species of Pinguicula L. have been recognised for India.

KEY TO GENERA

Calyx 5-lobed; roots present; traps absent;

leaves viscid glandular 1. Pinguicula

Calyx 2-lobed; roots absent; traps present; foliar
organs not viscid glandular 2. *Utricularia*

1. *Pinguicula*

L. Sp. Pl. 17. 1753 & Gen. Pl. ed. 5. 11. 1754; A. DC. in DC. Prodr. 8: 26. 1844; Benth. & Hook. f. Gen. Pl. 2: 988. 1876; Clarke in Hook. f. Fl. Brit. India 4: 335. 1884; Kamienski in Engler & Prantl, Nat. Pflanzenfam. IV. 3b: 118. 1893; Casper in Feddes Repert. Spec. Nov. Regni Veg. 66: 1. 1962. - LECTOTYPE: *Pinguicula vulgaris* L. (Britton & Brown, Ill. Fl. N.U.S. ed. 2. 3: 225. 1913).

Terrestrial herbs of wet places; roots numerous, filiform; stem rhizomatous, condensed, subterranean. Leaves in rosette, entire, sessile or petiolate, often with hyaline sheath, soft and fleshy, margin usually involute, covered on upper surface with viscid glands. Flowers solitary on naked scape. Calyx 2-lipped; upper lip 3- (-7) lobed; lower lip 2-lobed. Corolla yellow, white or various shades of pink to purple or blue, usually 2-lipped, throat with a hairy, often spotted palate; upper lip 2-lobed; lower lip 3-lobed; spur short to very long. Stamens short; filaments incurved; anthers globose. Pistil nearly as long as stamens; ovary more or less globose; style reduced; stigma usually bifid, lower well developed, upper usually reduced. Capsules globose to oblongoid-ellipsoid, laterally 2-valved or dehiscent irregularly. Seeds minute, numerous, oblongoid, rugose to tuberculate.

About 50 species; distributed circumboreally and in mediterranean regions extending to central and South America. One species in India.

Ecology: In damp, cold places.

Pinguicula alpina L. Sp. Pl. 17. 1753; Oliver in J. Proc. Linn. Soc., Bot. 3: 190. 1859; Clarke in Hook.f. Fl. Brit. India 4: 335. 1884; Smith & Cave in Rec. Bot. Surv. India 4: 230. 1911; Smith in Rec. Bot. Surv. India 4: 403. 1913; Kitam. in Fauna & Fl. Nep. Him. 226. 1955; Rao in Bull. Bot. Surv. India 1: 114. 1959; Rau in Bull. Bot. Surv. India 3: 237. 1961; Casper in Bibl. B. Stuttgart 127/128. 121, abb. 6, f-6, abb. 8, f. 12, abb. 32, f-7, abb. 1, f-5, 1966; Hara in Fl. E. Him. 2: 122. 1971; Taylor in Hara et al. Enum. Fl. Pl. Nepal 3: 131. 1982; Naithani, Fl. Chamoli 2: 477. 1985. - HOLOTYPE: "Habitat in Alpibus Lapponicus" (LINN, microfische !).

Herbs, up to 12 cm high; roots up to 4 cm long, simple, tubular, numerous; stem up to 2 cm long, rhizomatous, fibrous. Leaves up to 35 x 12 mm, linear to oblong, rosulate, numerous, fleshy, sessile, veins reticulate with prominent midrib, viscid glandular on upper surface, entire, involute, papery in lower part, acute to rounded at apex. Inflorescence scapose, 1-5, each 1-flowered. Flowers up to 16 mm long. Calyx bilipped, prominently nerved; upper lip 2-3.6 x 3-5 mm, 3-lobed, deltoid, obtuse to rounded at apex; lower lip 2-3.2 x 1.8-3 mm, 2-lobed, obtuse at apex.

Corolla cream-coloured, bilipped, hairy within; upper lip 2-5 mm long, 2-lobed, obovate to semiorbicular; lower lip up to 12 x 14 mm, 3-lobed, lobes unequal, varied in shape; spur c 2.5 mm long, obtuse at apex, papillose within, sparsely papillose without. Stamens c 3 mm long; filaments broad, strap-shaped, 1-nerved; anther thecae subdistinct. Pistil c 3 mm long; ovary c 1.5 mm across, globose; style distinct, stigma bilipped, upper lip subulate, ciliate along margin, lower semiorbicular. Capsules 4-5 x 2.5-3 mm, ellipsoid, ovoid to oblongoid, bivalved; placenta c 1.2 mm across, ovoid. Seeds up to 1 mm long, cylindrical, numerous, radially attached; testa reticulate, slightly tuberculate. (Fig. 4).

Fl. & Fr.: June to August.

Ecology: Grassy slopes, nullahs along the snowline, above 2100 m.

Distribution: Mediterranean regions of Europe extending east to Himalayas of Tibet, Nepal, Bhutan, N. Burma, China; in India restricted to Himalayan regions of Uttar Pradesh, Sikkim, Arunachal Pradesh and Assam. (Map 3).

Chromosomes: $n = 32$ (Virendra Kumar & Subramaniam 1986).

Notes: Graham (1839), casually mentioned about Pinguicula alpina L. in his Catalogue of Bombay Plants as used for ornament in Europe.

Specimens examined:

ASSAM: Way to Sadiya, 1950, Kingdon-Wards 19568 (ASSAM).

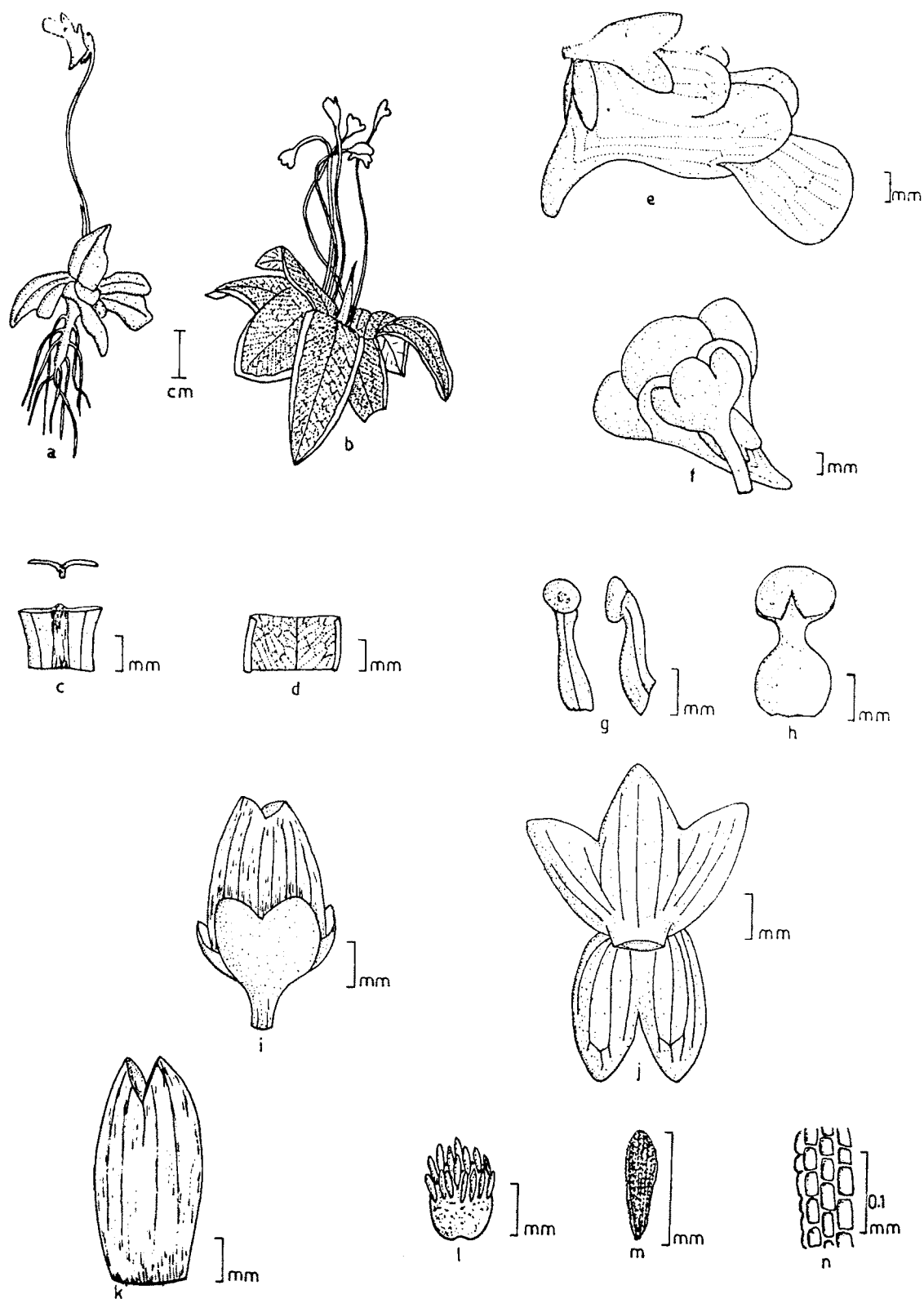
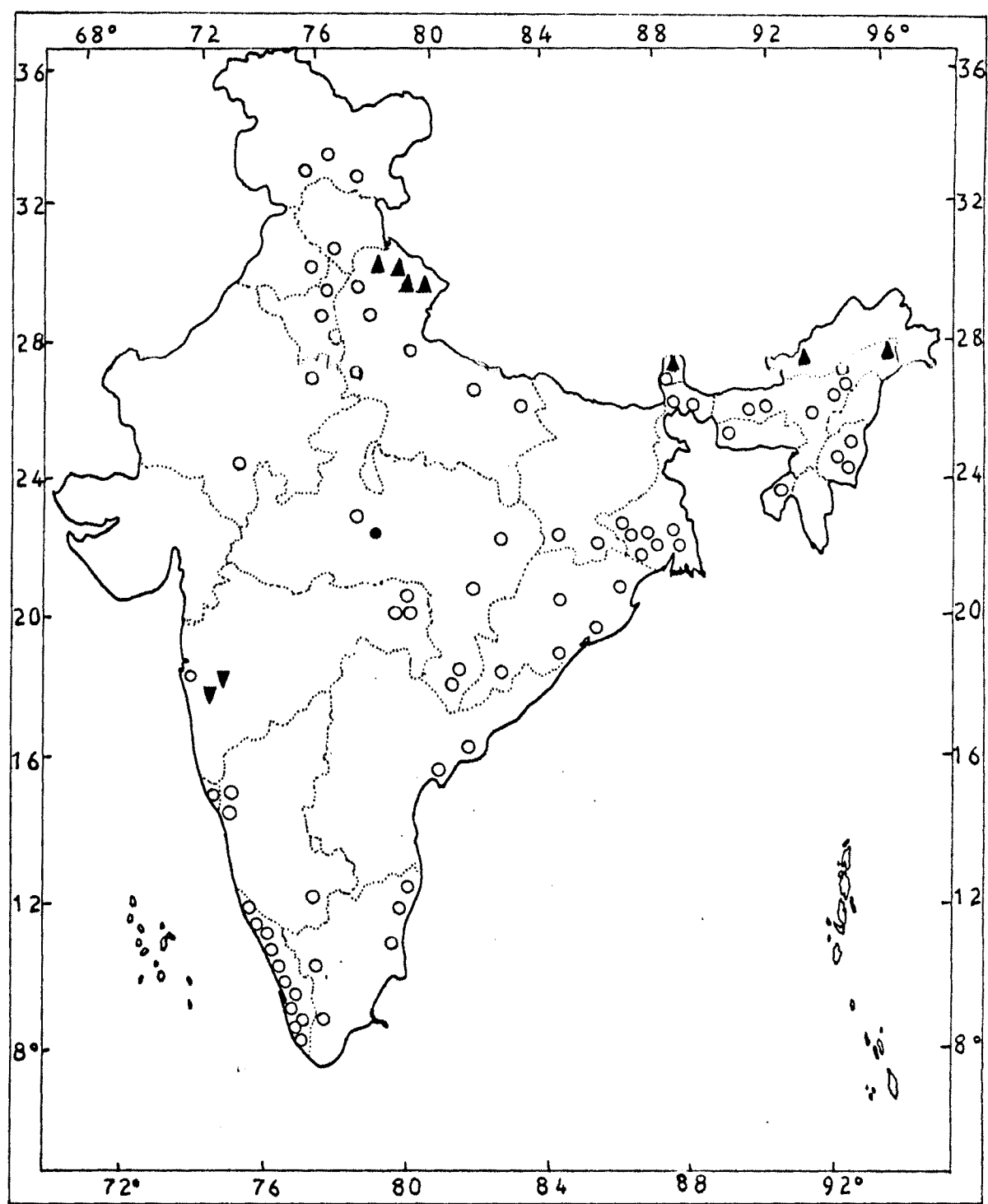


Fig. 4. *Pinguicula alpina* L.: a, b. Plants; c. Part of petiole with T.S.; d. A portion of leaf; e. Flower - lateral view; f. Flower - top view; g. Stamens; h. Pistil; i. Fruit; j. Fruiting calyx; k. Capsule; l. Placentum with few seeds; m. Seed; n. Testa cells.



Map 3. Distribution: ▲ *Pinguicula alpina* L.
▼ *Utricularia albocaerulea* Dalzell
● *U. arenaria* A. DC.
○ *U. aurea* Lour.

SIKKIM: Tsumtong (Yumtong), 11,000 ft., May 1885, R. Pantling s.n. (CAL, Acc. no. 330599); Above Chongthay, 7000 ft., May 1885, R. Pantling s.n. (CAL, Acc. no. 330600); Lachen, 9000 ft., May 1885, R. Pantling s.n. (CAL, Acc. no. 330601); Phemgaroo, 13,000 ft., July 1885, King's collector s.n. (CAL, Acc. no. 330598); Naka Chu, 16,000 ft., 4.8.1909, Smith & Cave 1973 (CAL); below Ninglan, 13,500 ft., 7.8.1910, W.W. Smith 4113 (CAL); Thangu - Lachen, 12-13,000 ft., 20.5.1945, K. Biswas 6924 (CAL); E. Himalayas, Mrs. Townsend s.n. (CAL).

UTTAR PRADESH: Kumaon, Puicri, 11,000 ft., 18.6.1882, H. Collett 120 (CAL); Kumaon, Pandar valley, Sunderdhunga, 10,500 ft., 16.6.1933, H.G. Champion s.n. (DD, Acc. no. 63098); Kumaon, Sunderdhunga valley, 12,000 ft., 28.5.1957, J. Anderson s.n. (CAL, Acc. no. 330592); Rishiganga valley, Garhwal, 3,500 m, 1.7.1957, M.A. Rau 2910 (BSD); Kumaon, Martoli - Milam, 4,500 - 4,000 m, 17.6.1958, T.A. Rao 6935 (BSD); Milam Buggyals, Kumaon, 4000 m, 20.6.1958, T.A. Rao 7100 (BSD); Chamoli dist., Badrinath, June 1979, U.C. Bhattacharya 66448 (BSD).

2. UTRICULARIA

L. Sp. Pl. 18. 1753 & Gen. Pl. ed. 5. 11. 1754; Vahl, Enum. Pl. 1: 194. 1804; Endl. Gen. Pl. 2: 728. 1839; A. DC. in DC. Prodr. 8: 3. 1844; Oliver in J. Proc. Linn. Soc., Bot. 3: 190. 1859; Benth. & Hook. f. Gen. Pl. 2: 987. 1876; Kamienski in Engler & Prantl, Nat. Pflanzenfam. IV. 3b:

119. 1893; Taylor in Kew Bull. 18: 23. 1964. - LECTOTYPE: Utricularia vulgaris L. (Britton & Brown, Ill. Fl. N.U.S. ed. 2. 3: 227. 1913).

Lentibularia Seguiet, Pl. Veron. 3: 128. 1754.

Meloneura Raf. Fl. Tellur. 4: 109. 1838.- Type: Meloneura^{*}
purpurea Raf. (= Utricularia striatula Sm.).

Diurospermum Edgew. in Proc. Linn. Soc. London 1: 351.
1848. - TYPE: Diurospermum album Edgew. (= Utricularia
kumaonensis Oliver).

Aquatic, terrestrial or epiphytic herbs. Rhizoids (root-like organs present at base of inflorescence) filiform, rarely thick and fleshy, often branched, branches botryform or filiform, papillose; stolons (stem-like organs present at base of inflorescence) filiform or capillary, growing horizontally in mud or submerged floating in water. Foliar organs (leaf-like organs present at base of inflorescence or on stolons) rosulate, scattered or semi-verticillate, dissected and capillary in aquatic species; linear, spatulate, orbicular and reniform or peltate in terrestrial and epiphytic species. Traps present on vegetative organs. Racemes erect or twining, bearing spongy floats in few aquatic species; scales on peduncle if present basifixed, medifixed or basisolute; bracts as in scales, at base of pedicel; bracteoles 2, along with bract or on pedicel, basifixed, medifixed or basisolute or absent, pedicels terete, or flattened and winged, erect or recurved in fruit. Calyx 2-lobed, usually accrescent. Corolla 2-lipped, yellow, white, blue to violet in colour; spur conical, subulate

or saccate. Stamens 2; filaments usually strap-shaped; anthers dorsifixed, thecae more or less distinct. Pistil more or less equal to stamens in length; ovary usually ovoid; ovules numerous on free central or axile placentation; style short, thick; stigma bilipped, lower lip often hairy, upper lip reduced. Capsules globose to ovoid, glabrous to papillose, circumscissile, valvate, porate, or dehisce by longitudinal slits often thickened along the dehisced margins. Seeds 1-many, variously shaped, often winged, glochidiate or comose; testa reticulate, scrobiculate, echinate or tuberculate.

About 180 species; cosmopolitan but mostly in tropical zone, almost half of which occur in the New World, the rest more or less equally distributed in tropical Africa, Asia and Australia with a few in the north temperate zone; 35 species in India.

Ecology: Marshes, wet grassy slopes, swamps, wet sandy soil, dripping rocks, tree trunks, ponds, lakes, paddy fields and ditches.

Pollen: The pollen grains of two species occur as tetrads; 3-5-colporate in terrestrial species and epiphytic species, 11-28-colporate in aquatic species. The ectoaperture is short in epiphytic species and elongated in others (Thanikaimoni 1966; Huynh 1968).

Chromosomes: Basic numbers of $n = 6, 7, 8, 9, 10, 11, 15, 20, 21$ are recorded. $2n = 56$ is recorded in U. uniflora R. Br. Only the aquatic species seem to have high basic

number of chromosomes as in U. aurea Lour. $n = 21$, U. stellaris L.f. $n = 21$, whereas in terrestrial species U. baouleensis A. Chev. $n = 10$, U. polygaloides Edgew. $n = 7$, U. scandens Benj. $n = 6$, U. recta (?) $n = 7$, U. minutissima Vahl $n = 8$ and U. caerulea L. $n = 20$.

KEY TO SPECIES

1. Aquatic, submerged floating herbs; foliar organs dissected into narrow segments; seeds prismatic or lenticular, winged:
 2. Primary foliar segments one or two:
 3. Ultimate foliar segments flattened; scales and bracts auriculate; capsule if present circumscissile; seeds prismatic, narrowly winged along edges:
 4. Foliar organs polymorphic, palmately divided; spur saccate 18. *U. minor*
 4. Foliar organs monomorphic, pinnately divided; spur cylindrical or broadly conical 4. *U. australis*
 3. Ultimate foliar segments terete; scales and bracts not auriculate; capsule valvular; seeds lenticular, broadly winged 10. *U. exoleta*
 2. Primary foliar segments three or more:
 5. Raceme with a whorl of ellipsoid floats atleast at a short distance above base; spur not constricted; hairs on corolla with globose glands.. . . . 31. *U. stellaris*

5. Raceme without floats or with fusiform floats
at base; spur constricted at middle; hairs on
corolla with cylindrical glands. 3. *U. aurea*
1. Terrestrial or epiphytic herbs; foliar organs entire;
seeds not as above:
 6. Foliar organs orbicular or reniform; placentation
axile; seeds with appendages:
 7. Seeds glochidiate, terminal appendages absent:
 8. Foliar organs only at scape base; lower lip
of corolla 4-lobed; seeds tangentially
attached to placentum, hilum lateral.. . . .
. 11. *U. furcellata*
 8. Foliar organs at scape base and on stolons;
lower lip of corolla 3- or 5-lobed; seeds
radially attached to placentum, hilum termi-
nal 32. *U. striatula*
 7. Seeds echinate or reticulate, terminal append-
ages present:
 9. Seeds with appendages on one end only, hilum
prominent; fruiting pedicel thick, recur-
ved 20. *U. multicaulis*
 9. Seeds with appendages on both ends, hilum
not prominent; fruiting pedicel slender,
not recurved:
 10. Foliar organs more or less orbicular;
capsule oblongoid, longer than upper calyx-
lobe; testa echinate. 15. *U. kumaonensis*

10. Foliar organs more or less reniform; capsule
subglobose, shorter than or equal to upper
calyx-lobe; testa reticulate. . . 7. *U. brachiata*

6. Foliar organs not as above; placentation free central;
seeds without appendages:

11. Bracts medifixed:

12. Foliar organs spatulate; appendages of trap
beak-shaped:

13. Flowers less than 6 mm long; spur longer
than lower lip of corolla; testa smooth.
. 8. *U. caerulea*

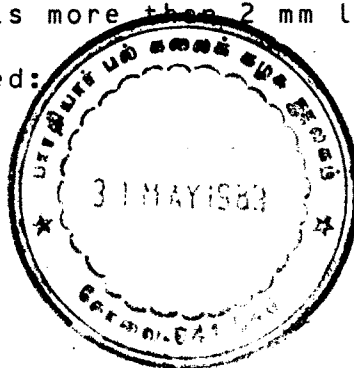
13. Flowers more than 8 mm long; spur shorter
than lower lip of corolla; testa papil-
lose or tuberculate. . 28. *U. roseopurpurea*

12. Foliar organs linear or peltate; appendages
of trap not as above:

14. Foliar organs peltate; appendages of trap
of comb-like radiating rows of gland
tipped hairs; capsule dehisce by a verti-
cal slit; bracteoles present; pedicels
up to 1 mm long. . . . 24. *U. pubescens*

14. Foliar organs linear; appendages of trap
of two antler-like processes; capsule
dehisce by a pore; bracteoles absent;
pedicels more than 2 mm long. 33. *U. subulata*

11. Bracts basifixed:



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15. Capsule wall thickened along dehiscent margin:

16. Raceme twining:

17. Flowers yellow; testa cells smooth

within 29. *U. scandens*

17. Flowers other than yellow; testa cells striated
within:

18. Flowers 15-25 mm long. . . 27. *U. reticulata*

18. Flowers less than 3 mm long. 5. *U. baouleensis*

16. Raceme erect:

19. Raceme glabrous; mouth of trap basal,
appendages two:

20. Flowers yellow 26. *U. recta*

20. Flowers other than yellow:

21. Foliar organs 1-nerved; testa cells
striated within . . . 22. *U. polygaloides*

21. Foliar organs 3- or more nerved; testa
cells not striated within:

22. Spur sickle-shaped, curved below
lower lip of corolla.

. 25. *U. purpurascens*

22. Spur conical, straight descending
down or slightly curved at apex:

23. Upper lip of corolla obovate,
lower 11-15 mm across; seeds
ellipsoid, hilum subterminal,
testa cells linear.

. 1. *U. albocaerulea*

23. Upper lip of corolla oblong, lower up to 7 mm across; seeds subglobose or obovoid, hilum terminal, testa cells oblong. 12. *U. graminifolia*
19. Raceme hairy or papillose; mouth of trap lateral or terminal, appendages 3- or more:
24. Raceme hairy throughout; mouth of traps lateral 13. *U. hirta*
24. Raceme papillose at least at base; mouth of traps terminal 2. *U. arenaria*
15. Capsule wall uniformly membranous:
25. Fruiting pedicel recurved:
26. Flowers yellow; calyx-lobes rounded at apex; testa cells finely striated within. 6. *U. bifida*
26. Flowers blue; calyx-lobes acute or acuminate at apex; testa cells not striated within 17. *U. malabarica*
25. Fruiting pedicel not recurved:
27. Flowers yellow; lower lip of corolla with a ligule at base 14. *U. keralensis*
27. Flowers other than yellow; lower lip of corolla without a ligule at base:
28. Scales numerous, not adpressed to peduncle 35. *U. wightiana*
28. Scales few, adpressed to peduncle:
29. Upper lip of corolla broader than calyx-lobe, obovate; lower lip more than 8 mm wide:

30. Lower lip of corolla 11-19 mm wide; seeds subglobose, intercellular space absent in testa cells 30. *U. smithiana*
30. Lower lip of corolla 9-10mm wide; seeds obovoid, intercellular space present in testa cells. 9. *U. cecilii*
29. Upper lip of corolla narrower than calyx-lobe, linear-oblong; lower lip less than 8 mm wide:
31. Spur horizontal; foliar organs 1-nerved; mouth of trap lateral 19. *U. minutissima*
31. Spur descending; foliar organs 3- or more nerved; mouth of trap basal:
32. Fruiting calyx-lobes unequal:
33. Spur shorter than or as long as calyx-lobe; seeds subglobose, testa cells more or less isodiametric, smooth within 21. *U. nayarii*
33. Spur atleast twice longer than calyx-lobe; seeds obovoid, testa cells elongate, verrucose within. 16. *U. lazulina*
32. Fruiting calyx-lobes more or less equal:
34. Seeds ellipsoid, hilum lateral or latero-terminal, testa cells elongated 23. *U. praeterita*
34. Seeds globose or subglobose, hilum terminal, testa cells more or less isodiametric. 34. *U. uliginosa*

1. *Utricularia albocaerulea* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 279. 1851; Oliver in J. Proc. Linn. Soc., Bot. 3: 177. 1859; Dalzell & Gibson, Bombay Fl. 135. 1861; Drury, Handb. Ind. Fl. 2: 120. 1866; Clarke in Hook.f. Fl. Brit. India 4: 330. 1884; Woodrow in J. Bombay Nat. Hist. Soc. 12: 176. 1898; Cooke, Fl. Bombay 2: 317. 1905 (2: 391. 1958 repr. ed.); Santapau in J. Bombay Nat. Hist. Soc. 49: 218. 1950; Bole & Almeida in J. Bombay Nat. Hist. Soc. 82: 72. 1985. - HOLOTYPE: Bombay, Vingorla, Dalzell s.n. (K, Photo !). (Photo 1).

Utricularia ogmosperma Blatter & McCann in J. Indian Bot. Soc. 10: 123. tt. 3 & 4. 1931, syn. nov. - HOLOTYPE: Maharashtra, W. Ghats, Panchgani, First Tableland, Blatter P70 (BLAT !, in publication given erroneously as P7 !).

Herbs, rhizoids up to 15 x 0.5 mm, thick at base, tapering towards apex, glandular, branches 1-2 mm long, arranged more or less alternately, papillose; stolons 2-5 cm long, capillary, c 0.2 mm thick, branched. Foliar organs up to 10 x 4 mm, linear to spatulate, at scape-base and on stolons, 3-nerved, nerves branched further. Traps 1-1.5 mm across, subdimorphic, those on foliar organs large, elsewhere small, subglobose; stalk c 0.3 mm; mouth basal; appendages subulate, often recurved, glandular-hairy. Racemes up to 15 cm long, 0.8-1 mm thick, erect, simple, grooved, winged, glabrous, 1-3-flowered; scales 1.3-2.5 x 1-1.8 mm, basifixed, lanceate to ovate, 1-3-nerved, truncate at base, acute to obtuse at apex; bracts 1.5-2.5 x

1.2-2 mm, basifixed, broadly ovate, 3-nerved, truncate at base, acute at apex; bracteoles 1-2 mm long, linear-subulate, acute at apex; flowers 9-13.5 mm long; pedicels 6-12 mm long, winged, recurved in fruit. Calyx-lobes ovate, sub-equal, papillose without; upper lobe 3.8-4.5 x 3-4 mm (7-7.5 x 6.5-7.5 mm in fruit), acuminate, rarely tridentate at apex; lower lobe 3.2-4 x 2.5-3.4 mm (6-7.5 x 5.5-6.5 mm in fruit), bidentate at apex. Corolla violet to dark blue, yellow in throat, papillose; upper lip 4.5-6 x 3-4.5 mm, obovate, emarginate to truncate at apex; lower lip 9-13 x 11-15 mm, ovate to obovate, often rectangular when spread, hairy along throat, white and bigibbous at base, truncate to emarginate at apex; spur 6-9 mm long, conical, slightly curved, acute at apex. Stamens 1.5-2 mm long; filaments broad, curved, 1-nerved; anther thecae distinct. Pistil 1.5-2.2 mm long; ovary compressed, ovoid; style distinct; stigma 2-lipped, lips obsolete or semi-orbicular. Capsules c 4.5 x 3 mm, compressed, ovate to orbicular in outline, dehisce longitudinally, thickened along dehisced margin; placenta 2.6-3.5 x 2-2.5 mm, compressed, ovoid. Seeds 0.3-0.4 mm long, oblongoid to ovoid, numerous; hilum subterminal, distinct; testa reticulate, cells compact, elongate. (Fig. 5).

Fl. & Fr.: October.

Local name: English-Blue bonnet; Marathi-Khajat Chaghas, Sita chi asre.

Ecology: On moist, gravelly laterite soil in open areas of hills.

Distribution: India; endemic to Southern Maharashtra and Northern Karnataka parts of Western Ghats. (Map 3).

Pollen: Isopolar, tetracolporate or pentacolporate, 4-5-lobed in polar view, elliptic in equatorial view; 24-25 x 31-33 μ . (Thanikaimoni 1966).

Notes: Utricularia albocaerulea Dalzell is allied to U. reticulata Smith, but differs in the erect inflorescence, 3-nerved foliar organs and absence of striations within the testa cells of seeds. Also allied to U. cecilii Taylor from which it can be differentiated by the presence of thickening along the dehiscent margin of capsule, latero-terminal hilum in seeds, absence of intercellular spaces in testa cells and often recurved fruiting pedicel. The capsule including seeds of U. albocaerulea is similar to that of U. purpurascens Graham, but the sickle shaped, long spur of the latter is quite distinct.

Utricularia ogmosperma Blatter & McCann described from Panchgani, W. Ghats was shown allied to U. albocaerulea. The former was distinguished from the latter on the basis of its broad, oblong-obovate bracts, narrowly obovate upper corolla lip, short and thick style, least recurved fruiting pedicel, broadly ovoid to almost orbicular, strongly flattened fruit, obliquely ellipsoid seeds and longitudinally and deeply multifurrowed testa. Bole & Almeida (l.c.) treated U. ogmosperma conspecific with U. arcuata Wight

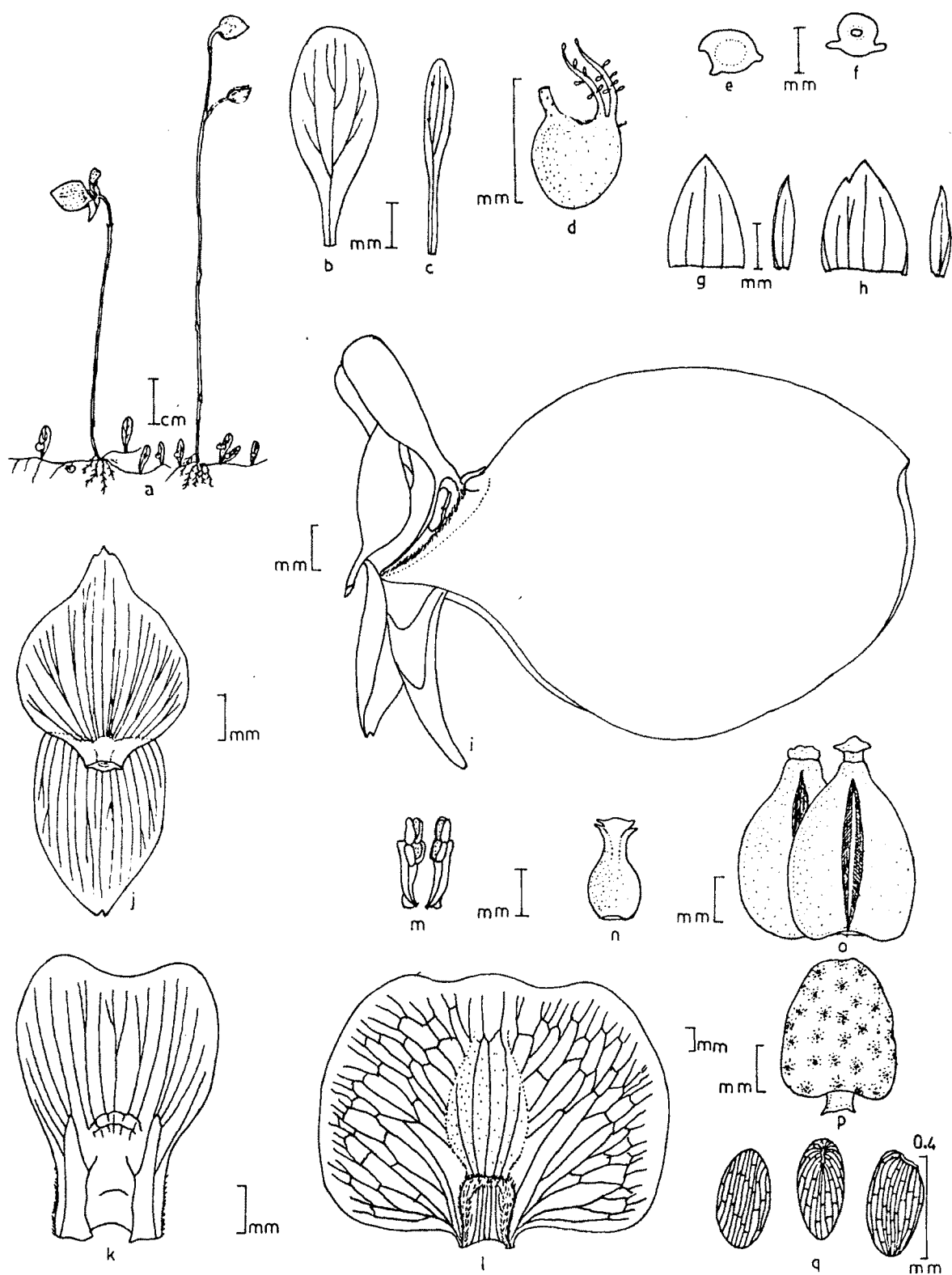


Fig. 5. *Utricularia albocaerulea* Dalz.: a. Plant; b, c. Foliar organs; d. Traps; e. T.S. of peduncle; f. T.S. of pedicel; g. Scale; h. Bract & bracteoles; i. Flower; j. Calyx; k. Corolla - upper lip; l. Corolla - lower lip; m. Stamens; n. Pistil; o. Capsules; p. Placental; q. Seeds.



Photo 1. *Utricularia albocaerulea* Dalzell (Holotype - K).

(=U. purpurascens Graham). Critical study of the type specimens kept in Blatter herbarium (BLAT), scrutinization of protologues and studies on pickled specimens (including specimens from the type locality of U. ogmosperma) revealed that U. ogmosperma falls within the limits of variation of U. albocaerulea and hence treated conspecific.

Specimens examined:

MAHARASHTRA: Satara dist., Panchgani, 6.9.1954, C. Saldanha s.j. CS 1531 (BLAT), Dt. 1954, M. Chennaveeraiah s.n. (BLAT, Acc. no. 54151), 13.10.1960, M.Y. Ansari 67560 (BSI), Mahabaleshwar, 5.10.1985, M.K. Janarthanam 82942 (MH), Panchgani, 7.10.1985, M.K. Janarthanam 82945, 82946 (MH).

'North Concan', Lawson s.n. (CAL, Acc. no. 330078); 'Malabar, Concan & Regio. trop.', Stocks & Law s.n. (CAL, Acc. no. 330077); 'Concan', Herb. Dalzell (CAL, Acc. no. 330076).

2. *Utricularia arenaria* A.DC. in DC. Prodr. 8: 20. 1844; Taylor in Kew Bull. 18: 107. 1964; Saxena in Indian Forester 92: 493. 1966; Srivastava in J. Econ. Tax. Bot. 4: 188. 1983. - HOLOTYPE: Senegal, St. Louis, Perrottet s.n. (G, microfische at CAL !).

Herbs; rhizoids capillary, few to many, at base or just above the base of inflorescence; stolons up to 5 cm long or more, filiform, branched. Foliar organs 2-15 mm long, obovate to oblanceate, at base of inflorescence and

scattered on stolons, 1-nerved, rounded at apex. Traps 0.3-1 mm across, globose, on vegetative organs, stalked; mouth terminal; appendages of radiating comb-like rows of gland-tipped hairs. Racemes up to 16 cm long, erect, filiform, usually papillose at base, 1-5-flowered; scales basifixed; bracts up to 1 mm long, basifixed, ovate-lanceate, 1-nerved, acute at apex; bracteoles up to 1 mm long, basifixed, lanceate, 1-nerved, acute at apex; flowers 1.5-7 mm long; pedicels 0.5-1 mm long. Calyx-lobes 1-2 mm long; upper lobe broadly ovate to orbicular, obtuse to acuminate at apex; lower ovate to oblong, truncate or rounded at apex. Corolla white or lilac with a yellowish upper lip and purple marked lower lip; upper lip longer than calyx-lobe, wider at base, truncate, emarginate or rounded at apex; lower lip orbicular or more or less quadrate, gibbous, crested at base; spur 1.5-6 mm long, horizontal, parallel to lower lip, subacute at apex. Stamens c 1 mm long; filaments curved, filiform; anther thecae subdistinct. Pistil c 1 mm long; ovary ovoid; style short; stigma 2-lipped, lower more or less orbicular, upper deltoid or semiorbicular. Capsules 1-2.5 mm across, broadly ovoid or globose, dehisce by marginally thickened adaxial and abaxial vertical slits; placenta areolate. Seeds conical, truncate, usually angular, numerous; testa smooth, cells small, more or less oblong.

Fl. & Fr.: September.

Ecology: Open wet places.

Distribution: Africa and India; in India, Pachmarhi hills of Madhya Pradesh. (Map 3).

Pollen: 'Pollen 6- (souvent 5-) aperture : 30 x 25 μ ' (Huynh 1968).

Notes: This African species was collected in India from Pachmarhi hills of Madhya Pradesh. Its occurrence in Rajpur, Dehra Dun as reported by Raizada and Saxena (Fl. Mussoorie I: 525. 1978) is erroneous, as the specimens quoted by them (Saxena 2327B, Rajpur, 950 m, 1.10.1961, DD) have since been identified as U. minutissima Vahl.

3. *Utricularia aurea* Lour. Fl. Cochinch. 26. 1790; A. DC. in DC. Prodr. 8: 8. 1844; Basak in Bull. Bot. Surv. India 17: 99. 1975 (1978); Srivastava, Fl. Gorakhpur. 23. 1976; Singh & Kachroo, Forest Fl. Srinagar 201. 1976; Taylor in Steenis, Fl. Males. I. 8: 296. 1977; Sharma & Tiagi, Fl. N.E. Rajasthan 306. 1979; Sharma & Kachroo, Fl. Jammu 1: 243. 1981; Varma, Fl. Bhagalpur 286. 1981; Manilal & Sivarajan, Fl. Calicut 208. 1982; Deb, Fl. Tripura 2: 304. 1983; Srivastava in J. Econ. Tax. Bot. 4: 188. 1983; Rani & Matthew in Matthew, Fl. Tamilnadu Carnatic 3: 1111. t. 84a. 1983; Guha Bakshi, Fl. Murshidabad 232. 1984; Wadhwa & Chowdhery in Chowdhery & Wadhwa, Fl. Him. Pradesh 2: 541. 1984; Rao, Fl. Goa 2: 308. 1986; Chandrasekaran in Henry et al. Fl. Tamil Nadu. I. 2: 129. 1987. - TYPE: "Habitat in fluviis lentioris cucus in Cochinchina." None assigned.

Utricularia vulgaris L. Sp. Pl. 18. 1753, partim quoad
ref. Fl. Zeyl.

Utricularia flexuosa Vahl, Enum. Pl. 1: 198. 1804; A. DC.
in DC. Prodr. 8: 24. 1844; Oliver in J. Proc. Linn. Soc.,
Bot. 3: 175. 1859, excl. syn. U. ramosa Vahl; Drury, Handb.
Ind. Fl. 2: 120. 1866; Clarke in Hook. f. Fl. Brit. India
4: 329. 1884, excl. syn. U. australis R. Br.; Trimen,
Handb. Fl. Ceylon 3: 267. 1895; Prain, Bengal Pl. 2: 780.
1903 (2: 582. 1963 repr. ed.); Cooke, Fl. Bombay 2: 316.
1905 (2: 390. 1958 repr. ed.); Duthie, Fl. Gangetic Plain
2: 166. 1911 (2: 38. 1960 repr. ed.); Haines, Bot. Bihar
Orissa 3 & 4: 644. 1922 (2: 676. 1961 repr. ed.); Gamble,
Fl. Madras 980. 1924 (2: 689. 1957 repr. ed.); Mayuranathan,
Fl. Pl. Madras 211. 1929; Mooney, Suppl. Bot. Bihar Orissa
102. 1950; Santapau in J. Bombay Nat. Hist. Soc. 49: 218.
1950; Subramanyam, Aquatic Angio. 33. 1962; Maheshwari,
Fl. Delhi 156. 1963; Oommachan, Fl. Bhopal 282. 1977;
Ugemuge, Fl. Nagpur 273. 1986. - TYPE: "Habitat in India
Orientale" Ex herbario Schumack (C ?).

Utricularia fasciculata Roxb. [Hort. Beng. 4. 1814, ^{nud.} nomen]
Fl. Ind. 1: 143. 1820; A. DC. in DC. Prodr. 8: 7. 1844;
Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849
& Ic. t. 1568. 1850. - TYPE: "Found swimming in stagnant
water in the vicinity of Calcutta, at the end of the cold
and beginning of the hot season"; none assigned.

Utricularia confervifolia Jack ex D. Don, Prodr. Fl. Nep.

84. 1825. - TYPE: "Hab. ad Narainhetty Nepalensium. Hamilton". (BM ?).

Utricularia stellaris sensu Joseph & Mani, Insect. Pl. Meghalaya 19. 1986, non L.f. 1781.

Submerged floating herbs; rhizoids usually absent, if present always 4, up to 10 x 0.6 cm, verticillate at base of raceme, inflated, fusiform, covered with foliar like segments; stolons up to 1 m long, c 2.5 mm thick, glabrous, floating below the surface of water, branched. Foliar organs up to 6 cm long, lanceate when spread; primary segments 3-5 per node, semiverticillate; secondary segments 2 from a point; ultimate segments capillary, terete, setulose; foliar scales rarely present, up to 13 mm across, dissected, setulose along margins. Traps 1-5 mm across, ovoid to obovoid, at axils of foliar organs and on secondary foliar segments, stalked; mouth lateral, oblique; appendages usually 2 or more in number, capillary, simple or branched, often with a ring of setae around mouth. Racemes up to 25 cm long, c 3 mm thick, up to 10-flowered; scales rarely present, similar to bracts; bracts 1.5-2 x 1.3-2 mm, basifixed, ovate to suborbicular, 1-nerved, truncate at base, acute to acuminate at apex; bracteoles absent; flowers up to 12 mm long; pedicels 7-18 mm long, recurved and distally thickened in fruit. Calyx-lobes subequal, ovate to oblong, fleshy, papillose at base, recurved or spread in fruit; upper lobe c 3 x 2 mm (up to 7 x 5 mm in fruit),

obtuse at apex; lower lobe c 2.5 x 2.2 mm (up to 7 x 4 mm in fruit), rounded to denticulate at apex. Corolla bright yellow; upper lip c 5 x 4 mm, ovate, hairy at base, obtuse to retuse at apex; lower lip c 6 x 9 mm, more or less obovate, hairy in throat, bigibbous at base, truncate, undulate at apex; spur more or less equal to lower lip in length, constricted at middle, papillose, glandular hairy at base, obtuse at apex. Stamens c 2 mm long; filaments curved, dilated above, papillose; anther thecae confluent. Pistil c 2 mm long, papillose; ovary subglobose; style thick; stigma 2-lipped, lower lip hairy, margin ciliate, upper lip obsolete. Capsules up to 7 mm across, globose with a long beak, circumscissile; placenta up to 5 mm long, ovoid. Seeds 0.8-1 mm across, polygonal, margin winged, hilum central; testa reticulate, cells more or less isodiametric. (Fig. 6; Photo 2).

Fl. & Fr.: August-April with a peak during October-February; flowering late in eastern parts of the peninsula.

Local name: Bengali-Janjee, Jhangi; Mundari - itka; Telugu-Natsoo.

Ecology: In stagnant or slow running waters from sea-level to high altitudes. The stolons and foliar organs are observed thick in ponds near coastal areas.

Distribution: Sri Lanka, India to Japan and south to Australia; in India distributed almost throughout the country. (Map 3).

Chromosomes: $n = 21$ (Subramanyam & Kamble 1968).

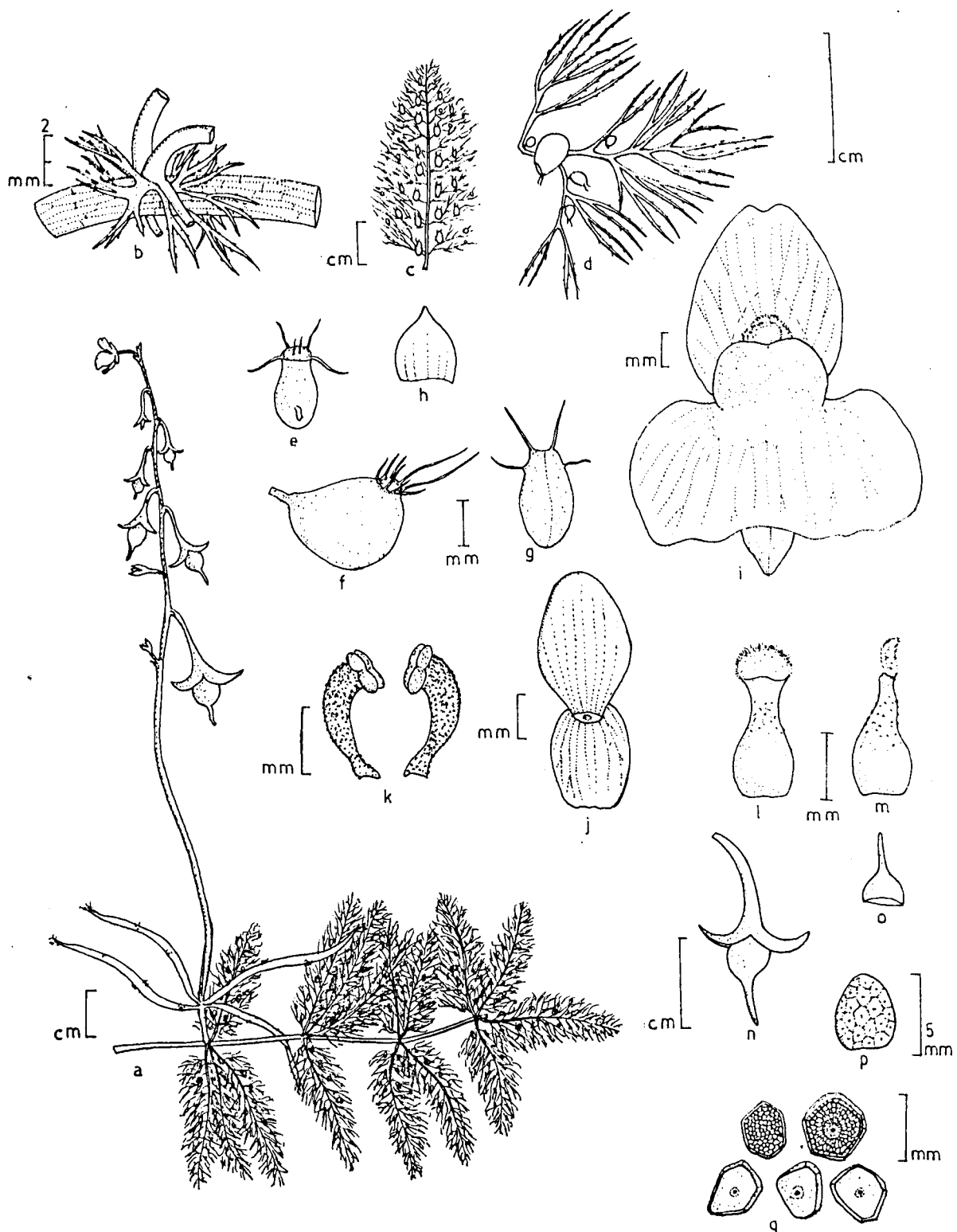


Fig. 6. *Utricularia aurea* Lour.: a. Plant; b. Stolon with auricles and bases of foliar organs; c. Foliar organ - primary ray; d. Foliar organ - secondary branches; e, f, g. Traps - different views; h. Bract; i. Flower; j. Calyx; k. Stamens; l. Pistil - adaxial view; m. Pistil - lateral view; n. Fruit; o. Capsule - detached cap; p. Placenta; q. Seeds.



Photo 2. *Utricularia aurea* Lour.

Pollen: Isopolar, 12-13-colporate, synorate; 12-13-lobed in polar view, spindle shaped in equatorial view. Longiaxe pollens 38-40 x 33-35 μ ; breviaxe pollens 30 x 35 μ . (Thanikaimoni 1966).

Notes: Rhizoids are usually absent in Utricularia aurea Lour., if present they give float-like appearance, often leading to the plants misidentified with U. stellaris L.f. However, in U. aurea the rhizoids are fusiform, and always four in number at the base of raceme. Further, U. aurea can be distinguished by its long-beaked capsule, and hairs on spur with cylindrical glands. Taylor (1977) distinguishes it from U. australis R. Br. on the basis of absence of scales on raceme and 3- or more primary foliar segments from a node. But the scales are often seen on the raceme of U. aurea rendering the character not useful.

Specimens examined:

ANDHRA PRADESH: West Godavari dist., Kolleru lake, 22.1.1958, K. Subramanyam 5073 (MH).

ASSAM: Jaboca, Tengali Bam Garden, 10.1898, M.A. Hock 137 (CAL); Gauhati, 16.11.1956, G. Panigrahi 4501 (ASSAM); Lakhimpur dist., Upper Diting R.F. 10.7.1959, G. Panigrahi 18969 (ASSAM); Jorhat town, 29.3.1962, J.G. Srivastava & party 79945 (LWG); Sibsagar, Barpadhar, 20.6.1963, D.B. Deb 35196 (ASSAM); Sibsagar, Sarupather, 31.10.1963, H. Deka 35513 (ASSAM); Nowgang dist., Tapatala, 20.8.1964, N.P. Balakrishnan 39323 (ASSAM, CAL); Kamrup dist., Chandubhi

lake, 22.10.1965, A.S. Rao 42480 (ASSAM); N. Lakimpur, Laluk, Adakhana, 18.5.1966, D.M. Verma 46463 (ASSAM); Assam, 27.10.1980, H. Deka 76953 (ASSAM).

BIHAR: Singhbhum, Chota Nagpur, Jursa 500 ft., 27.11.1883, C.B. Clarke 34395 E (CAL); Ranchi, 9.9.1896, Mokim s.n. (CAL, Acc. no. 330044).

KARNATAKA: Kanara, Jacombi, Feb. 1893, s.l. 22789 (BLAT); N. Kanara dist., Oct. 1919, Hall & McCann 35186 (BLAT); N. Kanara, 1600 ft., Oct. 1919, Ambo 7277 (BLAT).

KERALA: Paulghatcherry, Feb. 1849, Wight 2421 (CAL, MH); Cochin, Date 1884, M.A. Lawson s.n. (MH, Acc. no. 36526); Cochin, Nov. 1909, A. Meebold 470 (CAL); Quilon, 20.9.1913, Rama Rao's coll. 2257 (CAL); S. Malabar, Nedungayam, 18.11.1916, C.E.C. Fischer 4019 (CAL); Chowghat, 1.10.1948, C. Rajasekhara Mudaliar s.n. (MH, Acc. no. 93839); Payyanur, 3.10.1961, C. Saldanha CS 7281 (BLAT); Palghat dist., Olavakkot, 75 m, 17.10.1963, J. Joseph 17766 (CAL, MH); Trichur dist., Adirappalli R.F., 100 m, 11.12.1965, K.M. Sebastine 26741 (CAL, MH); Palghat dist., Peringothukavu, way to Kollengodu, 325 m, 23.11.1973, E. Vija^aravelu 44810 (MH); Trichur dist., Guruvayur, 10 m, 6.9.1976, K. Ramamurthy 47656 (MH); Cannanore dist., Nileswar, 175 m, 29.1.1979, V.J. Nair 59977 (CAL, MH), 9.10.1979, R. Ansari 64808 (CAL, MH), Cheruvathur, 50 m, 30.6.1980, R. Ansari 67929 (CAL, MH); Trichur dist., Pal^appara side R.F., 350 m, 22.9.1982, K. Ramamurthy 74716 (MH), Chiklai, 300 m, 29.9.1982, K. Ramamurthy 74935 (MH), Santhanathode area,

300 m, 26.11.1982, K. Ramamurthy 75551 (MH), Koratti-Chalakkudi route, 8.2.1984, 75 m, K. Ramamurthy 80433 (MH); Kasaragod dist., Kasaragod, Pallam Road, 23.8.1985, M.K. Janarthanam 82929 (MH).

MADHYA PRADESH: Central provinces, Chanda dist., 9.2.1889, J.F. Duthie 9639 (CAL, DD), 28.12.1889, J.F. Duthie 9640 (CAL, DD); Surguja state, Ambikapur, 31.5.1943, H.F. Mooney 2219 (DD); Bastar dist., Rajbhanda tank, Kanker, 17.11.1958, 500 m, K. Subramanyam 7148 (CAL, MH); Shivapuri dist., Chandpata, 30.1.1959, A. Singh & party 56040 (LWG); Saugar dist., Zalimpur tank, near Banda, 30.10.1960, 500 m, N.P. Balakrishnan 11347 (MH); Bastar, Narayanpur - Dhamtari, 30.3.1961, J.G. Srivastava 99112 (LWG); Bilaspur dist., Kota-Bilaspur road, 29.10.1970, G. Panigrahi 13043 (CAL).

MAHARASHTRA: Conditia, Sabatta Is., 18.1.1942, H. Santapau s.n. (DD, Acc. no. 91061; BLAT, Acc. no. 54018); Nagpur dist., Sakkardara, 16.11.1957, 217 m, K. Subramanyam 4649 (MH), Ramtek, 26.1.1959, Balapur & party 57528 (LWG), Umred, 17.12.1961, Ku.U.R. Nafday 81 BSI, CAL).

MANIPUR: 2-3000 ft., April 1882, G. Watt⁷⁴⁻⁵⁷ (CAL); Logtak lake, 2300 ft., 10.9.1944, N.L. Bor 18105 (DD), 2.6.1961, V. Singh 3 (CAL).

MEGHALAYA: Garo hills, Rongchengiri, 650 ft., 9.9.1962, D.B. Deb, 29332, 29336 (ASSAM).

ORISSA: Ganjam dist., Khariguda, 500 ft., Jan. 1884, J.S. Gamble 13710 (CAL); Puri, Sakhi Gopal, 4.3.1959, G. Saran & party 58121 (LWG); Padampur, 31.10.1959,

G. Panigrahi 20560 (ASSAM, CAL); Bhitar Kanika, 6.2.1961, G. Panigrahi 23749 (CAL); Korandi River Valley, East of Dodhari, 9.12.1962, G.V.S. Rao 30146 (ASSAM); Rayaghada-Kotagarh, 7.3.1964, S.L. Kapoor & party 64965 (LWG); Koksara Village, 16.3.1964, S.L. Kapoor & party 69850 (LWG).

SIKKIM: Tista, Terai, 22.2.1910, Ribu & Rhomoo, 3673, 3694 (CAL).

TAMIL NADU: Tirunelveli dist., Singampatti, 3.3.1958, 92 m, K.M. Sebastine 5503 (MH); Coimbatore dist., Anamalai, Pannimedu, 22.1.1963, J. Joseph 15564 (CAL, MH); South Arcot, Marakkanam, 9.9.1977, K. Ramamurthy 51125 (CAL); Chengalpattu dist., Neithavayal, 2.6.1986, M.K. Janarthanam 82984 (MH).

TRIPURA: Agartala, Tipperah hills, 30.9.1914, P.M. Debberman 153 (CAL), Oct. 1915, P.M. Debberman's coll. 813 (CAL).

UTTAR PRADESH: Kheri dist., Kotwara, 3.4.1898, Inayat 22424 (CAL, DD); Bhalaswa Gaj vill., 1953, R.C. Bharadwaja s.n. (LWG, Acc. no. 8524); Lucknow, Mohanlalganj, Karela lake, 1956, R.C. Bharadwaja s.n. (LWG, Acc. no. 16530); Bijnor, Dhampur, 18.3.1958, Yuvaraj K. Sarin 5195 (BSD); Jaunpur dist., Gujartal, Khetasara, 10.1.1962, N.P. Singh & C.L. Malhotra 10957 (BSD, CAL); Najibabad, 4.3.1962, C.L. Malhotra 19578 (BSD); Hamirpur, Mahoba, 19.7.1962, C.L. Malhotra 21466 (BSD); Buland Shahr dist., Daulatabad, 22.10.1962, N.P. Singh 25389 (BSD, CAL, LWG); Gorakhpur, Pharendsa, Bordan Lehri, 2.11.1963, C.M. Arora 1477 (CAL); Pilibhit, Amaria, 2.10.1970, C.L. Malhotra 42397 (BSD, CAL);

Dehra Dun, Selakui Chakrata Road, 29.8.1971, H.B. Naithani 3158 (DD); Bijnor dist., Chandpur, 11.11.1979, J.P. Sharma 70302 (BSD); Churela Tal, Dudhwa National Park, 22.4.1980, U. Shukla 70245 (BSD).

W. BENGAL: South of Calcutta, 10.11.1855, T. Thomson s.n. (CAL, Acc. no. 330012); Rajapore, Jheels, 3/67, S. Kurz s.n. (CAL, Acc. no. 330022); Jalpaiguri, Aug. 1879, J.S. Gamble 7031 (CAL, DD); Siliguri, Nov. 1879, J.S. Gamble 7408 (DD); Rajganga, 10.8.1914, M.S. Ramaswami 212 (CAL); Howrah, Thanamakuah, Oct. 1952, J.N. Naskar s.n. (CAL); Howrah, Makardeh, 25.11.1961, Banerjee 57 (CAL); 24-Parganas, Budge-Budge, 26.10.1962, Ghosh 996 (CAL); East Barisha, 25.1.1963, M.K. Ghosh 859 (CAL); Kamarkundu, 4.8.1963, B.V. Shetty 63 (CAL); Hooghly, Bandel, Polba, 15.11.1963, M.K. Ghosh 822 (CAL); Purulia dist., Saheb Bandh, 10.3.1964, S.N. Biswas 5 (CAL); Beshnupur Thana, Koch Birai river, 3.10.1964, M.N. Sanyal 299 (CAL); 24-Parganas, Falsa, 17.12.1964, M.K. Ghosh 2644 (CAL); Hooghly, Bandel, 19.12.1964, M.K. Ghosh 2664 (CAL); Mayapur, 19.12.1964, M.K. Ghosh 2672 (CAL); Digha, Midnapur, 27.2.1965, T.A. Rao, E 4110 (CAL); Howrah, Ghashpara Bally, 11.3.1965, L.K. Banerjee s.n. (CAL).

Tank at Sunwulli, 1882, W.A. Talbot (BSI, Acc. no. 6959); Jessore, 8.11.1896, Mokim s.n. (DD); Khulna, 1896, Shaik Mokim, (CAL, Acc. no. 330023); Rampur, 2.12.1944 Jameson s.n. (DD).

4. *Utricularia australis* R. Br. Prodr. 430. 1810; Saxena in Indian Forester 96: 249. 1970; Gandhi in Saldanha & Nicolson, Fl. Hassan 563. 1976; Taylor in Steenis, Fl. Males. I. 8: 299. 1977; Srivastava in J. Econ. Tax. Bot. 4: 188. 1983; Pandey et al. in J. Econ. Tax. Bot. 5: 865. 1984; Bennet, Name Chang. Fl. Pl. Ind. 580. 1987.- HOLOTYPE: Australia, March 1804, R. Brown 2730 (BM, Photo !). (Photo 3). *Utricularia flexuosa* sensu Clarke in Hook.f. Fl. Brit. India p.p. quoad syn. *U. australis* R. Br., non Vahl 1804. *Utricularia vulgaris* sensu Taylor in Kew Bull. 18: 71. 1964, non L. 1753.

Submerged floating herbs; rhizoids usually absent, if present up to 12 mm long, branches botryform; stolons up to 35 cm long, c 0.5 mm thick, filiform, terete. Foliar organs up to 2 cm long, primary segments dichotomously divided; ultimate segments setulose. Traps 1-2 mm across, obliquely ovoid, on nodes and foliar segments, stalked; mouth lateral, oblique; appendages 2, simple or branched, often setae present on lips. Racemes up to 20 cm long, flexuous, up to 10-flowered at regular intervals; scales 2-3 x 1.2-2.5 mm, basifixed, ovate to suborbicular, auriculate at base, acute to obtuse at apex; bracts c 3 x 2 mm, basifixed, ovate to suborbicular, auriculate at base, acute to obtuse at apex; flowers up to 12 mm long; pedicels 10-15 mm long, filiform, terete, erect at anthesis and spreading afterwards. Calyx-lobes subequal, ovate to oblong; upper lobe 2-2.5 x 1.8-2 mm, obtuse to acute at

apex; lower 2-2.5 x 1.9-2.5 mm, retuse or emarginate at apex, sparsely glandular without. Corolla yellow, c 12 mm long; upper lip c 5 x 3.5 mm, ovate to oblong, truncate at apex; lower c 6 x 12 mm, transversely elliptic, auricled and prominently gibbous at base, truncate at apex; spur c 4 mm long, conical, obtuse at apex, glandular within. Stamens 1.5 mm long; filaments dilated near anthers; anther thecae confluent. Pistil c 2 mm long; ovary globose, glandular; style short; stigma 2-lipped, lower lip deltoid, ciliate along margin, upper lip obsolete. Capsules and seeds not known. (Fig. 7).

Fl.: April-September.

Ecology: In still waters - ponds, lakes etc., normally at high altitudes.

Distribution: Western Europe to China and Japan, tropical and South Africa, Sri Lanka, India to southeast Australia (Taylor l.c.); in India it is known by its sporadic collections from Jammu & Kashmir, Himachal Pradesh, Punjab, Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra and Karnataka. (Map 4).

Note: Utricularia australis R. Br. is allied to U. aurea Lour. Clarke (l.c.) considered them conspecific. But they can be differentiated on the basis of 2-primary foliar segments and auricled bracts in the former, and 3-5-primary foliar segments, non auricled bracts and presence of cylindrical gland tipped hairs on the corolla of latter. Habitat is similar to that of U. aurea but more common in cold regions.

This species occurs sporadically. Collections are made from wide range of habitats like snow covered hilly areas of Kashmir, Himachal Pradesh to the desert areas of Rajasthan. Taylor (l.c.) describes this phenomenon as follows, "this widespread temperate Eurasian species apparently never sets seed and its somewhat sporadic occurrence, mostly at high altitude, in the African and Asian tropics is probably due to transmission of small particles of its vegetative parts by migratory birds". The turions which are present often in this species are not seen in any of the Indian materials studied.

Specimens examined:

HIMACHAL PRADESH: Rohru, 1600 m, 30.7.1965, N.C. Nair 36206 (BSD).

JAMMU & KASHMIR: Kashmir, Shopyian, 2000 m, 9.6.1959, T.A. Rao 9380 (BSD, CAL); Ranbirpur, Indus V, 3400 m, Ladakh, 13.9.1970, U.C. Bhattacharya 41150 (BSD).

KARNATAKA: Mysore dist., Gudihattikere, near Ketedevargudi, 23.4.1962, A.S. Rao 80285 (BSI).

MADHYA PRADESH: Indore-Pipliapala, S.K. Pandey s.n. (LWG, Acc. no. 62067).

MAHARASHTRA: Poona, March-April, 1867, G. King 35 (CAL).

PUNJAB: D.B. Nanak, Gurdaspur, 25.8.1969, U.C. Bhattacharya 39263 (BSD).

RAJASTHAN: Marwar, 1868, G. King s.n. (CAL, Acc. no. 33007); Jalore dist., Jaitpura, 28.9.1978, B.V. Shetty 6755 (BSJO).

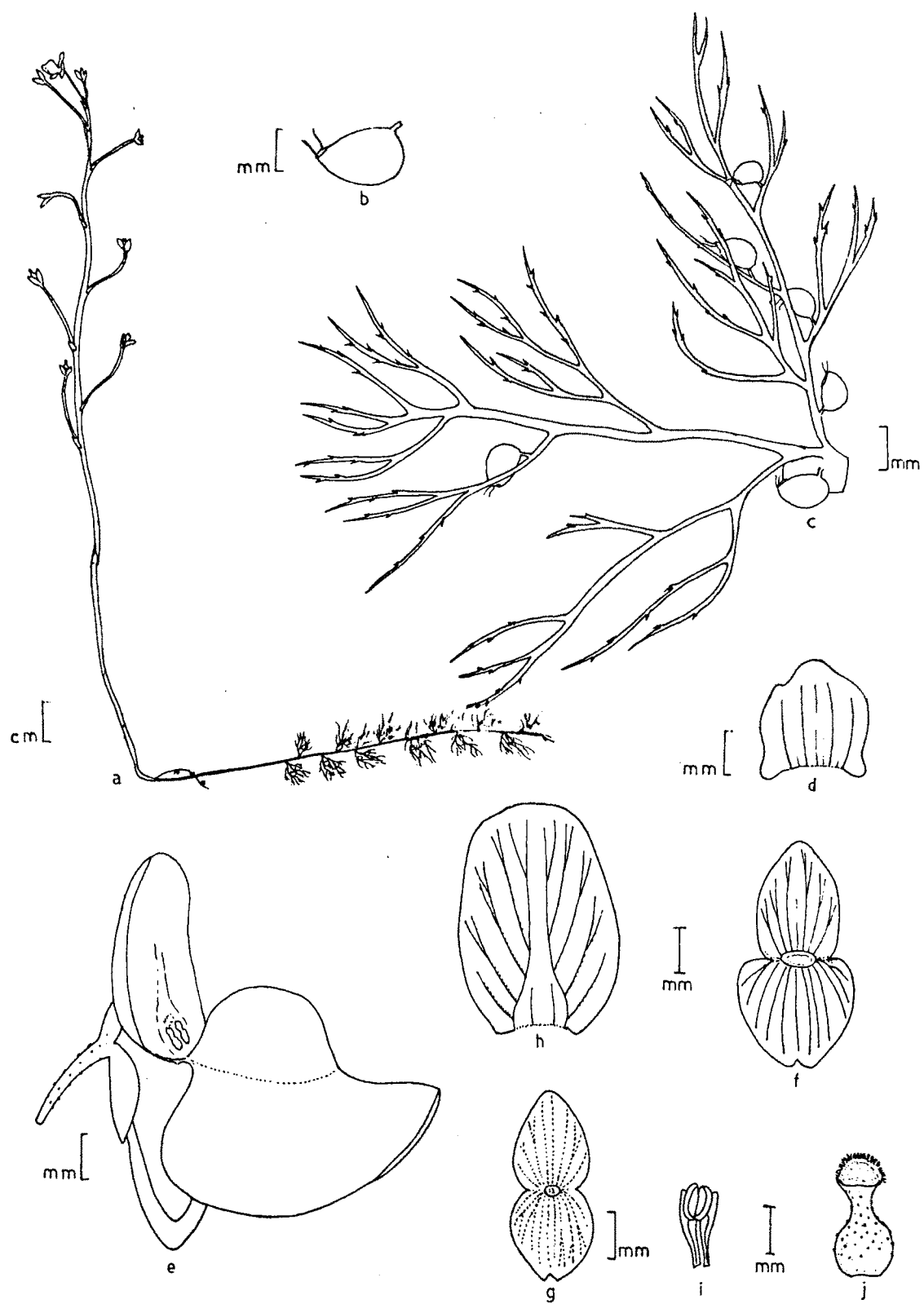
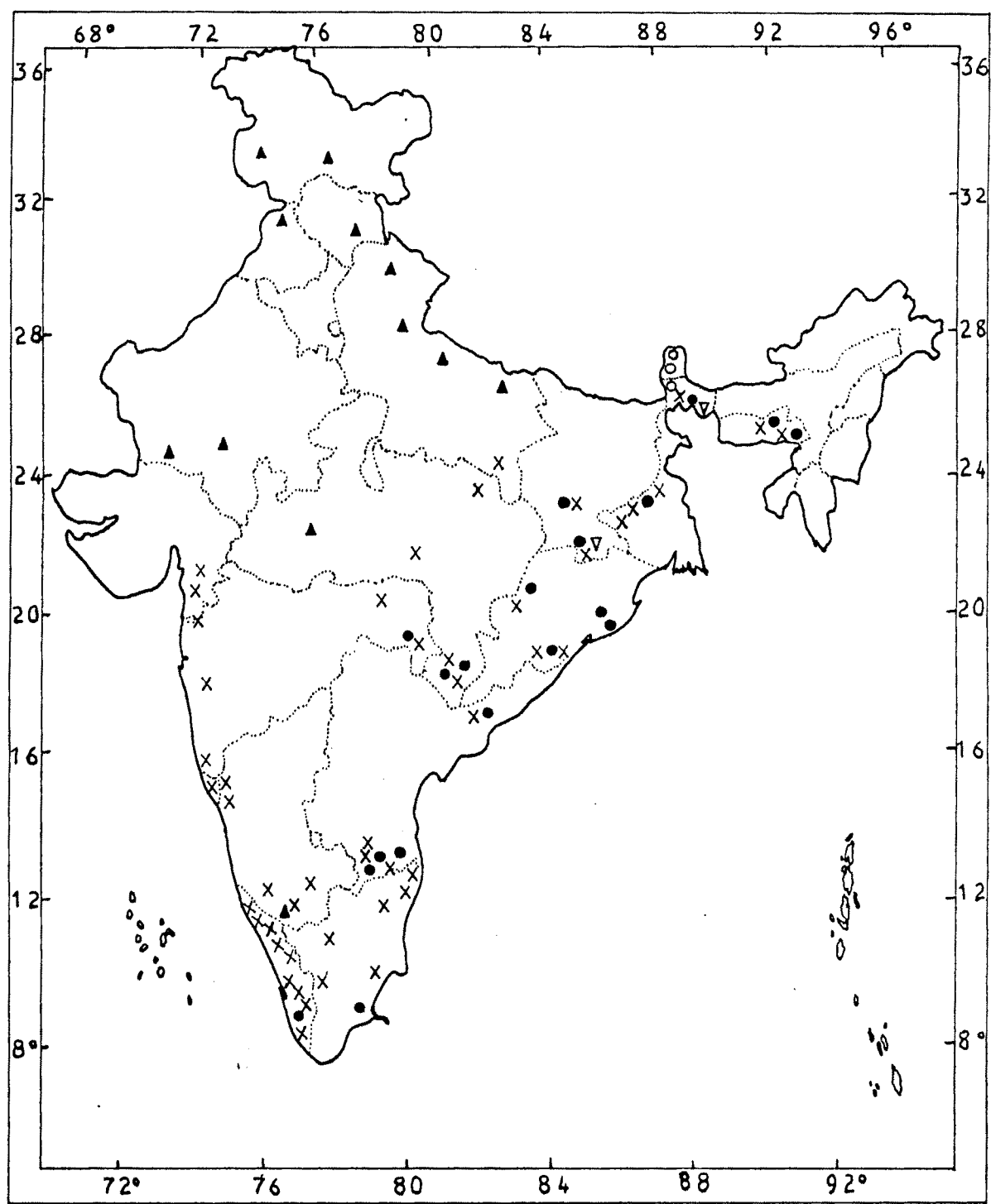


Fig. 7. *Utricularia australis* R. Br.: a. Plant; b. Trap; c. Foliar organ; d. Scale; e. Flower; f, g. Calyx; h. Corolla - upper lip; i. Stamen; j. Pistil.



Map 4. Distribution:

- ▲ *Utricularia australis* R. Br.
- ▼ *U. baouleensis* A. Chev.
- *U. bifida* L.
- *U. brachiata* Oliver
- x *U. caerulea* L.

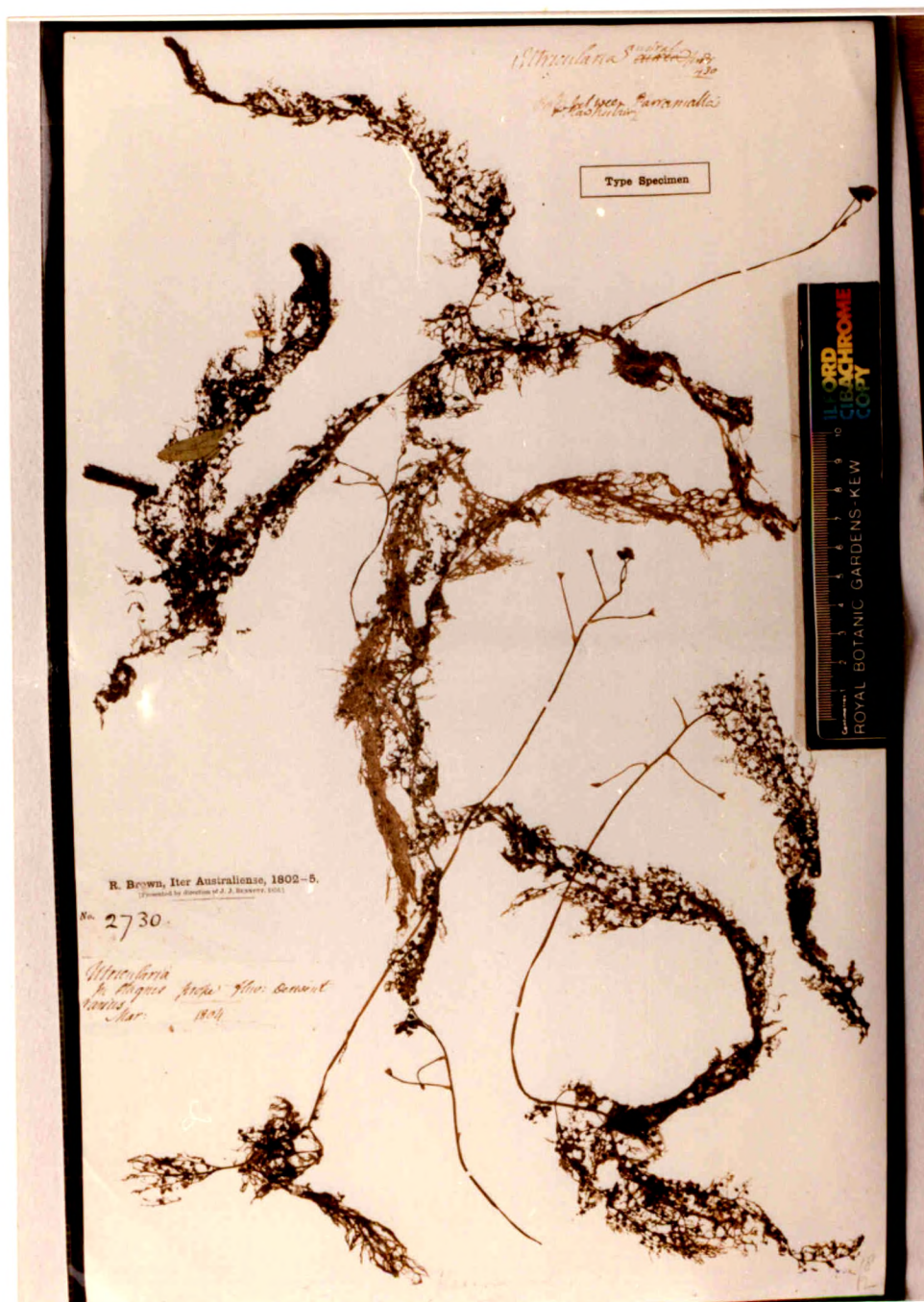


Photo 3. *Utricularia australis* R. Br. (Holotype - BM).

UTTAR PRADESH: Gorakhpur, 6.5.1898, Harsukh 224259 (CAL, DD); Garmukteshwar, 20.12.1959, T.A. Rao 10985 (CAL); Mahoba, Hamirpur, 30.9.1961, U.C. Bhattacharya 17958 (BSD, CAL), Belatal, 2.4.1962, U.C. Bhattacharya 21417 (BSD, CAL), Mahoba, 18.7.1962, C.L. Malhotra 21438 (BSD); Gola Gakaram Nath, Kotwara forest, Lakhimpur, G. Saran & party 2650 (LWG).

Goonah, Dr. King 12 (CAL).

5. *Utricularia baouleensis* A. Chev. in Bull. Soc. Bot. France 8: 186. 1912; Taylor in Kew Bull. 18: 69. 1964 & in Steenis, Fl. Males. I. 8: 284. 1977; Abraham & Subramanyam in Proc. Indian Acad. Sci. 62B: 98. 1965; Basak in Bull. Bot. Surv. India 17: 103. 1975 (1978); Srivastava in J. Econ. Tax. Bot. 4: 188. 1983; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 129. 1987. - HOLOTYPE: Ivory Coast, Baoule, Chevalier 22247 (P).

Utricularia scandens Oliver in J. Proc. Linn. Soc., Bot. 3: 181. 1859, non Benj. 1847; Drury, Handb. Ind. Fl. 2: 123. 1866; Clarke in Hook.f. Fl. Brit. India 4: 332. 1884; Prain, Bengal Pl. 2: 781. 1903 (2: 582. 1963 repr. ed.); Haines, Bot. Bihar Orissa 3 & 4: 646. 1922; (2: 677. 1961 repr. ed.); Gamble, Fl. Madras 982. 1924 (2: 690. 1957 repr. ed.). - HOLOTYPE: Madras in Herb. Hook. (K, Photo !).

Herbs; rhizoids up to 4 mm long, c 0.1 mm thick, capillary, branches papillose; stolons up to 5 cm long, c 0.1 mm thick, capillary, branched. Foliar organs up to 3 cm long,

linear, 1-nerved, scattered on stolons, acute or rounded at apex. Traps 0.8-1.2 mm across, globose on vegetative organs; mouth basal; appendages 2, subulate, branched. Racemes up to 30 cm long, filiform, twining, 1-5-flowered; scales c 0.5 x 0.5 mm, basifixed, ovate, acuminate at apex. Bracts c 1 mm long, basifixed, ovate to oblong, obtuse to shortly acuminate at apex; bracteoles c 0.5 mm long, linear-lanceate, acute at apex; flowers c 2 mm long; pedicels up to 3.5 mm long, slightly winged, erect at anthesis and recurved in fruit. Calyx-lobes unequal, ovate, obtuse to subacute at apex; upper lobe c 1.5 x 1.4 mm (2.5-3.3 x 1.7-2 mm in fruit); lower lobe c 1.8 x 1.1 mm (2.1-2.7 x 1.5-2.1 mm in fruit). Corolla pale blue or mauve; upper lip c 1 x 0.8 mm, oblong, truncate at apex; lower lip c 1.2 x 1 mm, ovate to orbicular, gibbous at base, rounded or obscurely 3-crenate at apex; spur 1 mm long, conical, acute at apex. Stamens c 0.8 mm long; filaments linear, straight; anther thecae subdistinct. Pistil c 1 mm long; ovary ovoid; style short, distinct; stigma 2-lipped, lower lip orbicular, upper lip smaller or obsolete. Capsules c 2 x 1.5 mm, ovoid, dorsiventrally compressed, dehiscent ventrally by a marginally thickened vertical slit; placenta c 1.1 x 0.9 mm, ovoid, smooth. Seeds 0.2-0.35 mm, ellipsoid; hilum terminal; testa reticulate, cells elongated, striated within. (Fig. 8).

Fl. & Fr.: September.

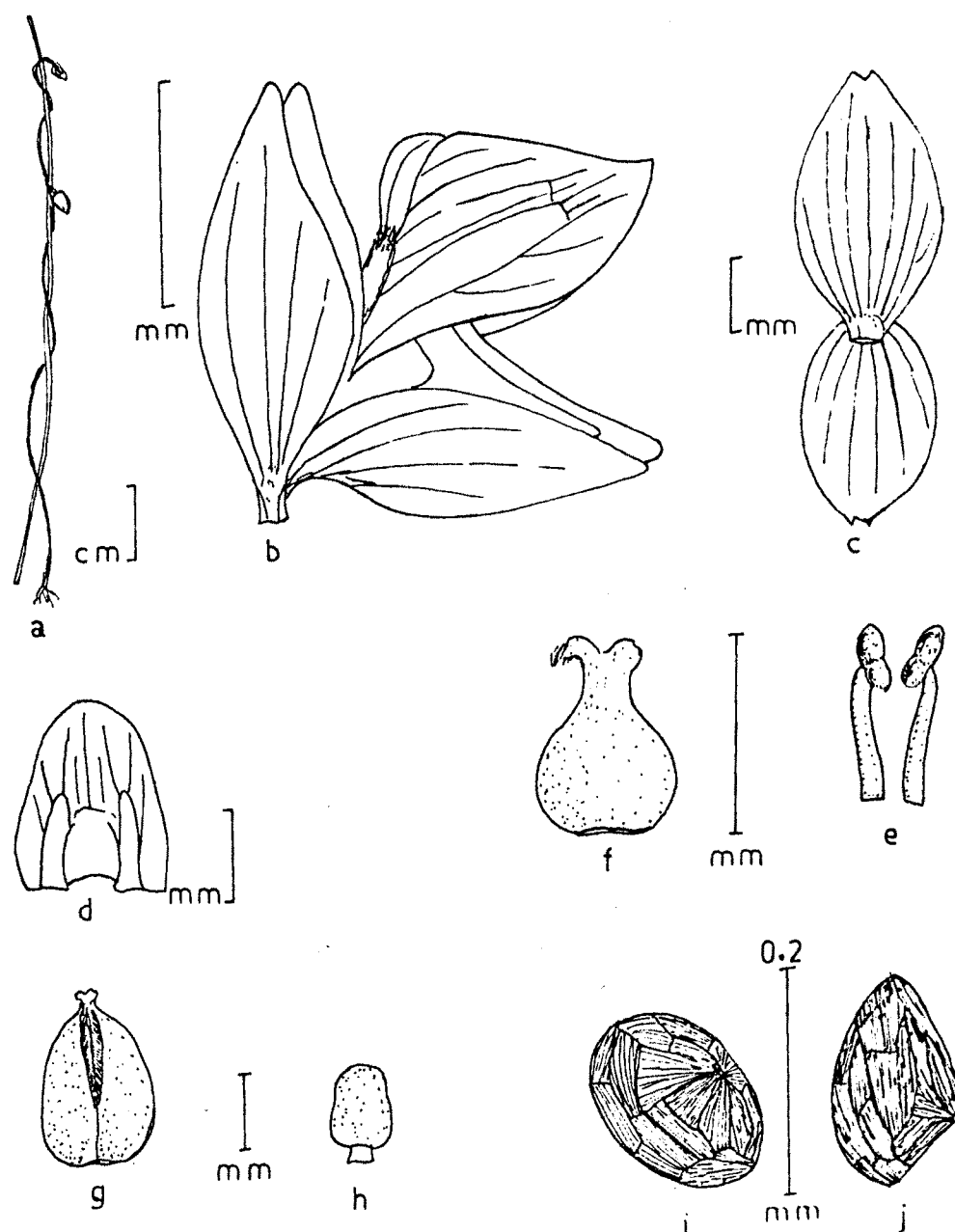


Fig. 8. *Utricularia baouleensis* A. Chev.: a. Plant; b. Flower; c. Calyx; d. Corolla - upper lip; e. Stamens; f. Pistil; g. Capsule; h. Placenta; i, j. Seeds.

Ecology: Along marshy places, twining on other utricularias and grasses.

Distribution: Tropical Africa to Australia, through India and China; in India distributed in Bihar, W. Bengal, Madhya Pradesh and Tamil Nadu (Map 4).

Pollen: 4-aperture; $24 \times 28 \mu$ (Huynh 1968).

Notes: Utricularia baouleensis A. Chev. is related to U. scandens Benj. and U. reticulata Smith. It can be differentiated from U. scandens by its blue coloured corolla, recurved fruiting pedicel, striated testa cells and branched appendages of traps; and from U. reticulata by its extremely smaller flowers and branched appendages of traps. Taylor includes this in U. foveolata Edgew. (vide CAL acc. no. 330160 - neotype of U. foveolata Edgew. proposed in July 1988), U. baouleensis is not well represented in Indian Herbaria. Except few old collections cited below, no other recent collections are present in the herbaria consulted. This may be due to its smaller flowers and twining nature on grasses which reduce the chances of spotting in the field.

Specimens examined:

BIHAR: Singhbhum, September 1899, H.H. Haines 207 (CAL).

W. BENGAL: Titalya, S. Kurz s.n. (CAL, Acc. no. 330160).

6. Utricularia bifida L. Sp. Pl. 18. 1753; Oliver in J. Proc. Linn. Soc., Bot. 3: 182. 1859; Drury, Handb. Ind. Fl. 2: 123. 1866; Clarke in Hook. f. Fl. Brit. India 4:

332. 1884; Prain, Bengal Pl. 2: 781. 1903 (2: 582. 1963 repr. ed.) & in Rec. Bot. Surv. India 3: 255. 1905; Haines, Bot. Bihar Orissa 384: 646. 1922 (2: 677. 1961 repr. ed.); Gamble, Fl. Madras 982. 1924 (2: 690. 1957 repr. ed.); Kanjilal, Fl. Assam 3: 386. 1939; Mooney, Suppl. Bot. Bihar Orissa 102. 1950; Abraham & Subramanyam in Proc. Indian Acad. Sci. 62 B: 98. 1965; Basak in Bull. Bot. Surv. India 17: 104. 1975 (1978); Gandhi in Saldanha & Nicolson, Fl. Hassan 563. 1976; Taylor in Steenis, Fl. Males. I. 8: 281. 1977; Balakrishnan, Fl. Jowai 2: 341. 1983; Srivastava in J. Econ. Tax. Bot. 4: 189. 1983; Sharma et al. Fl. Karnataka 195. 1984; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 129. 1987. - HOLOTYPE: CHINA, Osbeck s.n. (BM, microfische !).

Utricularia humilis Vahl, Enum. Pl. 1: 203. 1804. - TYPE: "Habitat in Indiae Orientale"; none assigned.

Utricularia ramosa Vahl, Enum. Pl. 1: 204. 1804. - TYPE: "Habitat in Indiae Orientale, Konig" (C?).

Utricularia wallichiana Benj. Bot. Zeitung (Berlin) 3: 213. 1845. - TYPE: "Patria Nepalia (Wall.) Herb. n. 1498 B (K, CAL).

Herbs; rhizoids up to 15 mm long, capillary, branches up to 1 mm long, papillose; stolons up to 3 cm long, filiform, branched. Foliar organs up to 10 x 0.5 mm, linear, on stolons, 1-nerved, rounded at apex. Traps c 1 mm across, globose, on vegetative organs; stalk thickened distally; mouth basal; appendages 2, subulate, simple. Racemes 2.5-18 cm long, erect, 1-8-flowered; scales 1-1.5 mm long, basifixed, ovate,

acute at apex, nerves 1 or 5, or absent; bracts 1.2-2.5 mm long, basifixed, ovate to linear-lanceate, 1- or 3-nerved, acute at apex; bracteoles 0.7-1.5 mm long, subulate; flowers 5-13 mm long; pedicels 2-5 x 1-1.5 mm, broadly winged, erect in anthesis, recurved in fruit. Calyx-lobes subequal, ovate; upper lobe 2-4 x 2-3 mm (3-6 x 2.5-4.5 mm in fruit), rounded at apex; lower lobe 2-3 x 2-3 mm (3-5.5 x 2.5-4.5 mm in fruit), rounded and rarely bi- or tridentate at apex. Corolla yellow; upper lip 2-6 x 1-2 mm, linear-oblong, rounded at apex; lower lip 2.5-6 mm across, orbicular to obovate, hairy in throat, gibbous at base, rounded at apex; spur 3-6 mm long, subulate, descending, acute at apex. Stamens c 1.5 mm long; filaments strap shaped, 1-nerved; anther thecae distinct. Pistil c 1.5 mm long; ovary ovoid; style short, distinct; stigma 2-lipped, lower lip slightly reflexed, upper lip represented by a semiorbicular projection. Capsules 2-3 x 1.5-2.5 mm, ovoid, slightly compressed, wall uniformly membranous; placenta c 1.5 mm across, more or less globose, stalked. Seeds 0.25-0.4 mm long, ovoid, ellipsoid to obovoid, numerous; hilum lateral; testa reticulate, cells large, elongate, striated within. (Fig. 9).

Fl. & Fr.: July-December.

Local names: Bengali-Chotajhangi; Santali-Arak Jhawar.

Ecology: In wet and marshy areas near perennial water sources, falls, streams, lakes and in rice fields from sea-level to 1500 m.

Distribution: Sri Lanka to Japan and South to North Australia; in India throughout the country except Northwest India. (Map 4).

Pollen: Isopolar, tricolporate or tetracolporate, 3-4-lobed in polar view, elliptic in equatorial view (Thanikaimoni 1966).

Notes: Utricularia bifida L. is allied to U. recta M.K. Janarthanam among Indian species, but can be easily distinguished by its recurved fruiting pedicel, rounded apices of calyx-lobes, uniformly membranous capsule wall and presence of striations within the testa cells.

This species is used in Indian medicine for urinary disorders.

Specimens examined:

ANDHRA PRADESH: Kambakkam hills, 17.3.1901, Bournier 2155 (CAL), 6.5.1913, C.A. Barber 8948 (MH), 27.8.1922, C.E.C. Fischer 4752 (CAL), 31.8.1958, P.B. Kamath 718 (PCM); Visakhapatnam dist., on the way to Tanjavanam 16.10.1982, G.V. Subba Rao 42625 (MH); Chittoor dist., Seethalam river bed, Thandipandal, 25.9.1974, M. Chandrabose 45099 (MH), near Akkagari Gudi, 1.10.1974, G.V. Subba Rao 45938 (MH).

ASSAM/Khasia, Kurz 155 (CAL).

BIHAR: Hazaribagh, 200 ft., 25.11.1874, C.B. Clarke 24884 (CAL); Netarhat, Upper Ghaghara falls, 16.8.1956, V. Chandra & party 36412 (LWG); Singhbhum, Sept. 1899, H.H. Haines 206 (CAL).

KERALA: Quilon, 5.9.1895, T.F. Bourdillon Esq., 689 (CAL); Travancore, C.C. Calder & Ramaswami 807 (CAL); Ranni, 27.7.1978, C.N. Mohanan 58341 (MH).

MADHYA PRADESH: Bastar, Bailadila, 3,500 ft., 6.10.1940, H.F. Mooney 1463 (DD); Dangadamunda lake - Kondegaon, 19.11.1958, K. Subramanyam 7211 (CAL, MH).

MAHARASHTRA: Chandrapur dist., Katejhari plot 116, 27.2.1971, B.M. Wadhwa 133536 (BSI).

MEGHALAYA: Khasia, Nov. 1859, Masters s.n. (CAL); Garampani, Forksi, 23.8.1968, N.P. Balakrishnan 46998 (ASSAM), Raliang to Garampani, 1300 m, 23.11.1969, N.P. Balakrishnan 50145 (ASSAM); Nongpoh, Nonglam, 3000 ft., 15.10.1980, J. Joseph 76947 (ASSAM).

ORISSA: Sambalpur, s.d., Griffith 4081 (CAL); Ganjam dist., Kukhara Khandi, Dec. 1889, J.S. Gamble 21650 (CAL); Athmallik state, Udal, 5.5.1947, H.F. Mooney 2865 (DD); Balukhand Forest, 13.10.1965, A.V. Abraham 267 (CAL); Chandrabaga/Konark Coast, 26.10.1967, A.K. Mukerjee 6056 (CAL).

TAMIL NADU: Ramanathapuram, Esani Forest, 16.12.1964, K. Ramamurthy 22731 (MH).

W. BENGAL: N. Bengal, Siliguri & Titalya, 27.10.1868, S. Kurz s.n. (CAL, Acc. no. 330186); Birbhum dist., Santiniketan, 7.9.1949, K. Biswas 4297 (CAL); Donula, Nov. 1886, Prain s.n. (CAL, Acc. no. 330190), Manbhum, 1886, A. Campbell Ex. No. 334 (CAL, DD).

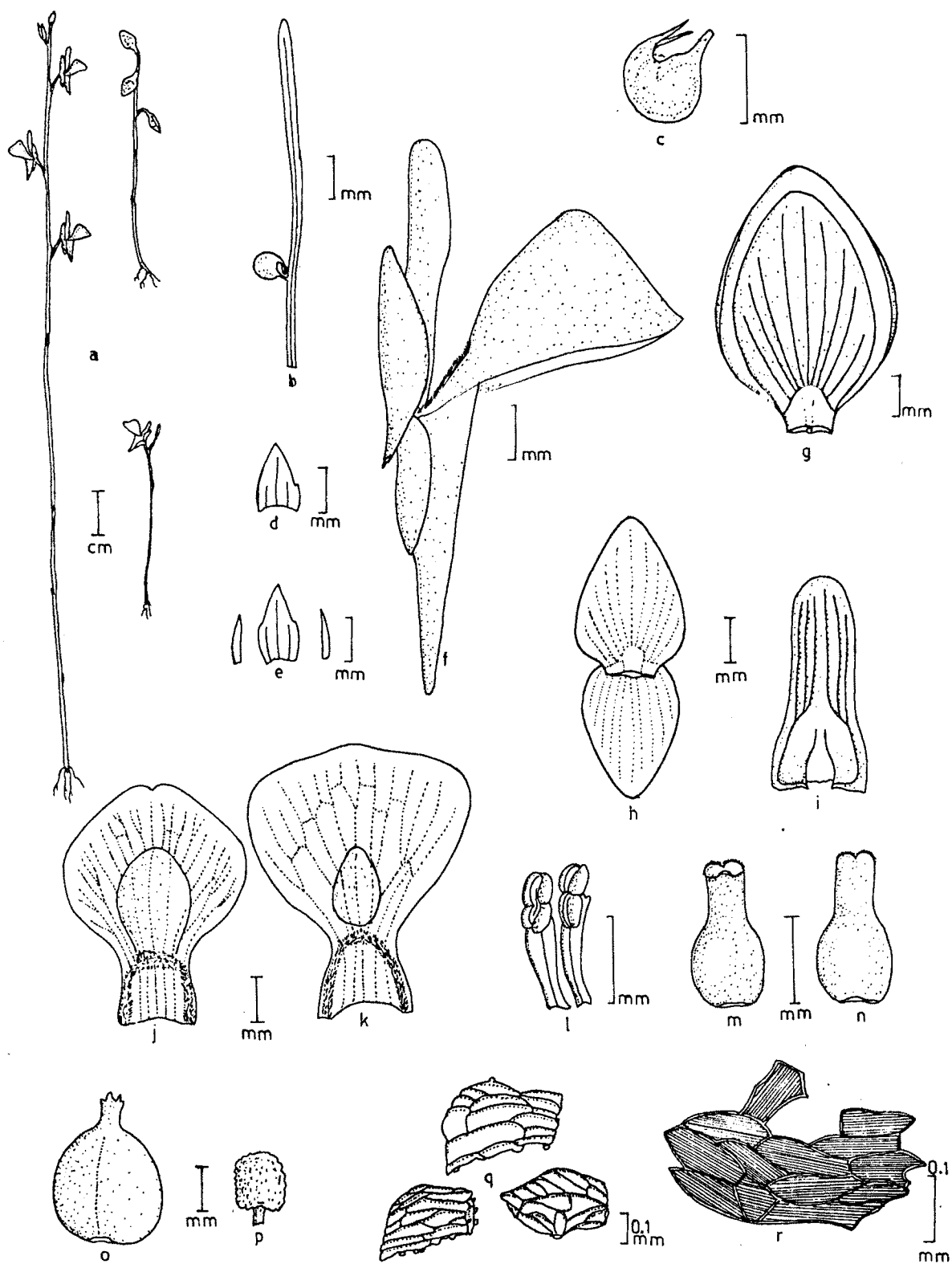


Fig. 9. *Utricularia bifida* L.: a. Plants; b. Foliar organ with trap; c. Trap; d. Scale; e. Bract & bracteoles; f. Flower; g. Fruit with calyx lobes; h. Calyx; i. Corolla - upper lip; j, k. Corolla - lower lip; l. Stamens; m. Pistil - adaxial view; n. Pistil - abaxial view; o. Capsule; p. Placentum; q. Seeds; r. Testa cells.

Anakayam block 2, 24.9.1958, R. Indra 469 a (PCM);
11/1856, Beddome 104 (CAL).

7. *Utricularia brachiata* Oliver in J. Proc. Linn. Soc., Bot. 3: 187. 1859; Clarke in Hook.f. Fl. Brit. India 4: 333. 1884; Smith & Cave in Rec. Bot. Surv. India 4: 230. 1911; Smith in Rec. Bot. Surv. India 4: 403. 1913; Fischer in Rec. Bot. Surv. India 12: 117. 1938; Basak in Bull. Bot. Surv. India 17: 105. 1975 (1978); Taylor in Hara et al., Enum. Fl. Pl. Nepal 3: 132. 1982. - LECTOTYPE: (3) Lachen, 10-11,000 ft., 3.8.1849 (K, Photo !). (Photo 4).

Herbs; tubers c 2 mm across, globose; rhizoids up to 8 mm long, filiform, few, simple; stolons up to 1 cm long, filiform, simple^P. Foliar organs with pseudopetiole up to 2 cm long, rosulate, expanded portion c 4 x 4 mm, reniform, nerves dichotomously branched. Traps up to 1.5 mm across, obliquely ovoid, on vegetative organs; mouth lateral; appendages represented by expanded upper lip terminating in radiating hairs. Racemes up to 8 cm long, filiform, erect, 1-flowered; bracts c 2 mm long, medifixed, upper limb lanceate, lower limb oblong, irregular at base, acute at apex; bracteoles c 1.5 mm long, medifixed; flowers terminal, up to 1 cm long; pedicels up to 7 mm long, filiform, terete, erect in flower, erect or recurved in fruit. Calyx-lobes unequal, papillose; upper lobe up to 4 x 5.3 mm, broadly ovate, denticulate or shallowly lobed at apex; lower lobe up to 2 x 1.6 mm, more or less oblong, bifid

or truncate at apex. Corolla white; upper lip slightly bilipped or emarginate; lower lip 5-lobed, throat yellow; spur c 6 mm long, slightly curved, linear, shorter than lower lip of corolla, obtuse at apex. Stamens and pistil not seen. Capsules c 3 x 3 mm, subglobose, oblique, attached to upper calyx-lobe at base, dehisce vertically at ventral side; placenta c 1.5 mm long, flask shaped, connecting apex and base of capsule. Seeds 0.4 mm long, elliptic; hilum indistinct; testa reticulate; appendages on both ends few, long, thick. (Fig. 10).

Fl. & Fr.: July-October.

Ecology: In Himalayas above 2400 m; epiphytic on moss-covered trunks.

Distribution: Endemic to Eastern Himalayas; Nepal, India, Bhutan and Southwest China; in India found in W. Bengal, Sikkim and Arunachal Pradesh. (Map 4).

Pollen: Isopolar, tricolporate or tetracolporate, circular in polar view, elliptic in equatorial view; 32-35 x 46-50 μ (Thanikaimoni 1966).

Notes: Utricularia brachiata Oliver is allied to U. kumaonensis Oliver, but can be easily distinguished by the presence of tubers at the base of inflorescence, reniform foliar organs, 1-flowered racemes, subglobose capsule, and smooth, reticulate testa.

U. brachiata, endemic to Eastern Himalayas, is meagrely represented in herbaria; this may be due to the rarity of expeditions of botanical nature at higher elevations.

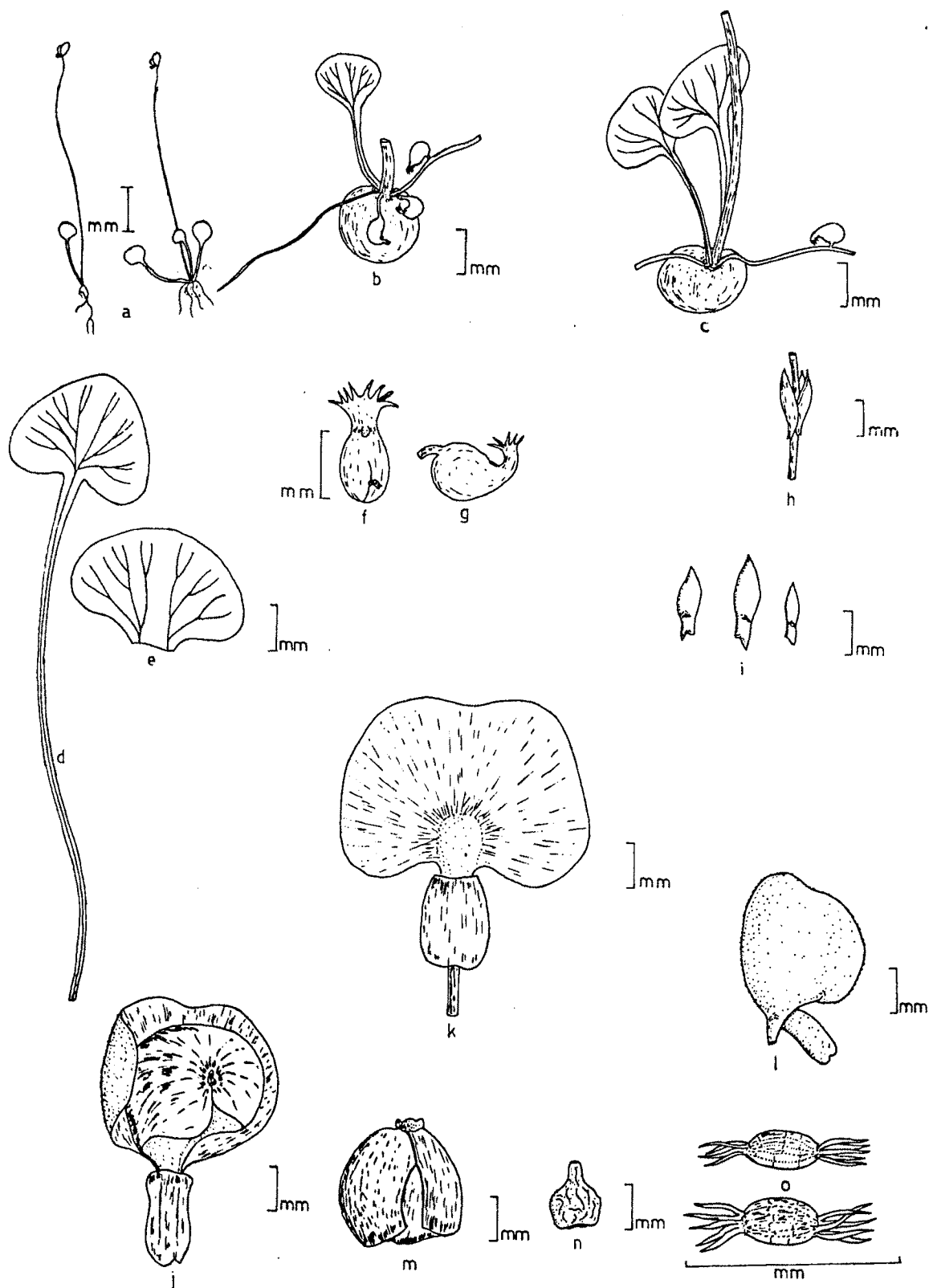


Fig. 10. *Utricularia brachiata* Oliver: a. Plants; b, c. Tubers and foliar organs at scape base; d. Foliar organ; e. Foliar organ (expanded portion only); f, g. Traps - different views; h. Bract & bracteoles attached to scape; i. Bracts & bracteoles; j, l. Fruit - different views; k. Fruiting calyx; m. Capsule - dehiscent; n. Placental; o. Seeds.



Photo 4. *Utricularia brachiata* Oliver ("3" Lectotype - selected - K).

Oliver (l.c.), while describing U. brachiata quoted "In Himalaya Orientali temperata, pro. Sikkim, Lachen, inter muscos, alt. 8-11000 ped., J.D. Hooker." The protologue includes three different collections: 1. Sikkim, J.D. Hooker; 2. Lachen, 8000 ft., 4.8.1849; and 3. Lachen, 10-11000 ft., 3.8.1849, which were studied by Oliver but mounted on the same sheet vide Photo no. 4. Taylor (in Herb. Kew) erroneously pointed out the collection number '3' (collected from Lachen, 10-11000 ft., 3.8.1849) as 'holotype' of the species. According to the "Code" this should be designated only as 'lectotype' of the species.

Specimens examined:

SIKKIM: 11000 ft., 1.8.1892, G.A. Gammie s.n. (BSI); Zemu Valley, 23.7.1909, Smith & Cave 1733 (DD).

W. BENGAL: Suburkum, 11000 ft., 1.10.1906, I.H. Burkill 27687 (CAL).

8. *Utricularia caerulea* L. Sp. Pl. 18. 1753; Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 374. 1849 & Ic. t. 1583. 1850; Haines, Bot. Bihar Orissa 3 & 4: 645. 1922 (2: 676. 1961 repr. ed.); Gamble, Fl. Madras 983. 1924 (2: 691. 1957 repr. ed.); Fyson, Fl. S. Ind. Hill. St. 1: 438. 1932 & 2: t. 378. f. 1. 1932; Barnes, Suppl. Fl. Pl. Madras 27. 1938; Santapau in J. Bombay Nat. Hist. Soc. 49: 217. 1950; Ramasamy & Razi, Fl. Bangalore 546. 1973; Basak in Bull. Bot. Surv. India 17: 101. 1975 (1978) & 21: 216. 1979 (1981); Gandhi in Saldanha & Nicolson, Fl.

Hassan 564. 1976; Taylor in Steenis, Fl. Males. I. 8: 287. 1977, excl. syn. U. rose^opurpurea Stapf ex Gamble; Shah, Fl. Gujarat 1: 514. 1978; Naik, Fl. Osmanabad 240. 1979; Raghavan et al. in Rec. Bot. Surv. India 21: 63. 1981; Rao & Razi, Syn. Fl. Mysore 531. 1981; Srivastava in J. Econ. Tax. Bot. 4: 189. 1983 excl. var. graminifolia (Vahl) Bhattacharyya; Sharma et al. Fl. Karnataka 195. 1984; Verma in Verma et al. Fl. Raipur 266. 1985; Ugemuge, Fl. Nagpur 273. 1986; Rao, Fl. Goa 2: 308. 1986. - LECTOTYPE: Ceylon (Sri Lanka), Hermann 23 (BM, Photo !).

Utricularia nivea Vahl, Enum. Pl. 1: 203. 1804; Roxb. Fl. Ind. 1: 144. 1820; Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849 & Ic. t. 1582. 1850; Oliver in J. ^{Proc.} Linn. Soc., Bot. 3: 186. 1859; Dalzell & Gibson, Bombay Fl. 135. 1861; Drury, Handb. Ind. Fl. 2: 125. 1866; Cooke, Fl. Bombay 2: 319. 1905 (2: 393. 1958 repr. ed.); Basak in Bull. Bot. Surv. India 17: 101. 1975 (1978); Sharma et al. Fl. Karnataka 196. 1984. - HOLOTYPE: Ceylon (Sri Lanka), Koenig s.n. (C).

Utricularia racemosa Wall. ex Walp. in Meyen, Observ. Bot. 19: 401. 1843; A. DC. in DC. Prodr. 8: 21. 1844; Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 374. 1849 & Ic. t. 1584. f. 1. 1850; Oliver in J. Proc. Linn. Soc., Bot. 3: 186. 1859; Drury, Handb. Ind. Fl. 2: 125. 1866; Clarke in Hook. f. Fl. Brit. India 4: 333. 1884; Prain, Bengal Pl. 2: 781. 1903 (2: 582. 1963 repr. ed.); Rama Rao, Fl. Pl. Travancore 294. 1914; Fyson, Fl. Nilgiri & Pulney Hill

tops 1: 308. 1915. - TYPE: Silhet, Wallich; Herb. Heyn.; Wall. Cat. no. 1496 (K, Photo !, CAL !).

Utricularia filicaulis Wall. ex A. DC. in DC. Prodr. 8: 21. 1844; Oliver in J. Proc. Linn. Soc., Bot. 3: 186. 1859.- TYPE: Nepal, 1821 Wallich; Tavoy, W.G. (Wall. Cat. no. 1501) (K, CAL !).

Utricularia squamosa Benj. Bot. Zeitung (Berlin) 3: 212. 1845. - TYPE: Patria India Orientalis, Nepal.

Utricularia paucifolia Benj. in Linnaea 20: 309. 1847. - HOLOTYPE: Indo-Orient, De Friedland (B, microfische !).
Utricularia purpurea Willd. ex Benj. in Linnaea 20: 309. 1847, pro. syn.

Utricularia racemosa Wall. ex Walp. var. filicaulis (Wall. ex A. DC.) Clarke in Hook.f. Fl. Brit. India 4: 333. 1884.
Utricularia caerulea L. var. filicaulis (Wall. ex A. DC.) Gamble, Fl. Madras 983. 1924 (2: 691. 1957 repr. ed.); Barnes, Suppl. Fl. Pl. Madras 28. 1938.

Utricularia sampathii Subramanyam & Yoganarasimhan in J. Indian Bot. Soc. 60: 123. 1981, syn. nov. - HOLOTYPE: India, Karnataka, Bangalore, Bannerghatta, 3.11.1976, Subramanyam and Yoganarasimhan 123 (CAL !).

Herbs; rhizoids 3 cm long, glandular, rarely branched; stolons up to 2 cm long, 0.1-0.3 mm thick, sparsely glandular, branches hyaline. Foliar organs 4-8 x 1-1.3 mm, spatulate, rosulate, 1-6 per node on stolons, 1-nerved, rounded to obtuse at apex. Traps 1-2 mm long, ovoid, on vegetative organs; stalk short; mouth terminal with a rim of glandular

hairs; upper lip extended into a beak-shaped appendage, glandular. Racemes 3.5-40 cm long, 0.5-1 mm thick, simple or rarely branched, terete or flattened, glabrous, flowers clustered at apex or lax; scales 1.5-4 x 0.7-1 mm, medifixed, elliptic to rhomboid, 1-nerved; bracts 1.5-5 mm long, medifixed, elliptic to rhomboid, sparsely papillose without, 1-nerved; bracteoles 1-2 mm long, linear, basiolute, papillose; flowers up to 8 mm long; pedicels up to 2 x 0.4 mm, erect, terete, often recurved in fruit, papillose. Calyx-lobes subequal, hooded, papillose; upper lobe 2-2.5 x 1.5-2.5 mm, broadly ovate to orbicular, obtuse or rarely acute at apex; lower lobe 1.5-2.5 x 1.5-2 mm, obovate, rounded or notched at apex. Corolla purple, pink, rose, blue, violet, white or cream-coloured, papillose; upper lip 2-4 x 1.5-1.8 mm, oblong to rarely deltoid, constricted at middle with two horn like projections on ventral surface, ciliate at lower margin, truncate, notched or emarginate at apex; lower lip 1.5-5 x 2-4.5 mm, semiorbicular to broadly ovate, yellow in throat, gibbous at base, rounded or shallowly 3-lobed at apex; spur 3-5 mm long, longer than lower lip, horizontally projected, often curved upwards, acute or notched at apex. Stamens c 1 mm long; filaments strap-shaped, curved, 1-nerved; anther thecae distinct. Pistil c 1 mm long; ovary ovoid, attached to upper calyx-lobe at base; style short; stigma 2-lipped, lower semiorbicular and hairy, upper filiform and glabrous. Capsules 1.5-2 mm across, subglobose to obliquely ovoid,

papillose, dehisce vertically by a ventral slit; placenta c 1 mm across, subglobose, pitted. Seeds 0.2-0.3 mm long, ovoid, ellipsoid to obovoid; hilum terminal; testa reticulate, cells elongate. (Fig. 11; Photo 5A, 6C).

Fl. & Fr.: August-December along West Coast, Northeast India and W. Bengal; August-April in East Coast and Central India with a peak in December-February.

Local name: Mundari-Otejugi.

Ecology: On wet or marshy open sandy soil, mud and gravelly areas, under both seasonal and perennial conditions, from sea level upwards.

Distribution: Sri Lanka, India to Japan, Malesia and Australia; in India distributed in Eastern and North-eastern, Central and Southern states: Uttar Pradesh, Bihar, W. Bengal, Meghalaya, Orissa, Madhya Pradesh, Gujarat, Goa & Dadra, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka and Kerala. (Map 4).

Chromosomes : $n = 20$ (Subramanyam & Kamble 1968).

Pollen: Pollen isopolar, tricolporate or tetracolporate, 3-4-lobed in polar view, elliptic in equatorial view. (Thanikaimoni 1966).

Notes: Utricularia caerulea L. was much discussed regarding its taxonomy, nomenclature and typification. Oliver (l.c.) and Clarke (l.c.) applied the name to the Koenig's specimen present in LINN (= U. graminifolia Vahl). Bhattacharyya (1976) applied it to the 'Nelipu' of Van Rheede (= U. reticulata Smith). Basak (1979) clarified the

doubts regarding the typification of U. caerulea and followed Smith's (1805) lectotypification of Hermann 23 (BM). Recently, Bhattacharyya (1986) proposed the name for rejection, as he felt that it was most confusing. Nicolson (Pers. Comm. dated 12.2.1988) wrote that "The Spermatophyta Committee has not yet come to a decision but they have realized that Basak's paper (1979) on the typification of this species was not mentioned in the proposal and probably will vote against rejection on the understanding that Dr. Bhattacharyya's is not imposed by the code." Hence the name U. caerulea L. is followed in this treatment.

Critical examination of the type material and analysis of protologue of Utricularia sampathii Subramanyam & Yoganarasimhan show that it is only a variable form of U. caerulea L.

Specimens examined:

ANDHRA PRADESH: Chittoor dist., Mahimandalam, 23.10.1921, C.E.C. Fischer 4685 (CAL), Madanapalli, 2500 ft., 27.12.1921, C.E.C. Fischer 4710, 4712 (CAL); Visakhapatnam dist., on way to Tanjavanam, 16.10.1972, G.V. Subba Rao 42621 (MH); Chittoor dist., Akkagarigudi, 1.10.1974, G.V. Subba Rao 45935 (MH).

BIHAR: Chota Nagpur, Hazaribagh lake, 15.10.1883, C.B. Clarke 33807 A (DD), 18.10.1883, C.B. Clarke 33850 (CAL); Doumda, Nov. 1885, Prain s.n. (CAL, Acc. no. 330252, 330280); Singhbhum, Sep. 1899, H.H. Haines 208 (CAL); Netarhat, Upper Ghagna falls, 16.8.1956, V. Chandra & party 36415 (LWG).

DADRA: Dadra, 29.9.1963, M.Y. Ansari 93837 (BSI, CAL).

GOA: Bicholim - Sanquelim, 10.9.1965, John Cherian 106082 (BSI); Bicholim -Ponda, 12.9.1965, John Cherian 106117 (BSI, CAL); Malem-Belgaum Road, 17.9.1970, N.P. Singh 124274 (BSI); Malem, Awnedam, 18.9.1970, N.P. Singh 124356 (BSI).

KARNATAKA: N. Kanara, Yellapure, 15.9.1884, W.A. Talbot 1047 (CAL); Mysore, Kumsi, 2-3000 ft., Oct. 1908, A. Meebold 9795 (CAL); Mysore, Agumbe, 4.11.1960, R.S. Raghavan 68169 (BSI); Namadachilume, 30.8.1961, Seshagiri Rao Rolla 73440 (BSI); Barakona, Agumbe, 16.10.1962, R. Sundararaghavan 83273 (BSI); Barakona, Agumbe, 31.8.1963, R. Sundararaghavan 90356 (BSI).

KERALA: Quilon, 23.9.1913, M. Rama Rao & K. Venkoba Rao 2244 (CAL); Travancore State, C.C. Calder & M.S. Ramaswami 809 A (DD); Wynaad, Kamblakad, 11.10.1961, C. Saldanha CS 7513 (BLAT); Trivandrum dist., Kottur R.F., 27.9.1973, J. Joseph 44432 (MH); Trichur dist., Adirappalli Reserve, 13.9.1976, K. Ramamurthy 48490 (CAL, MH); Quilon dist., Perumalai, Konni R.F., 18.11.1976, M. Chandrabose 49117 (CAL, MH); Ranni, 27.7.1978, C.N. Mohanan 58340 (MH), Kozhencherry, 7.12.1979, C.N. Mohanan 63705 (MH); Kasaragod dist., Kanhangad, Ramnagar, 20.8.1985, M.K. Janarthanam 82917 (MH), Periya, 20.8.1985, M.K. Janarthanam 82919 (MH), Mulleriyar, 21.8.1985, M.K. Janarthanam 82923 (MH); Calicut dist., Iringal, 25.8.1985, M.K. Janarthanam 82933 (MH);

Palghat dist., Malampuzha, 15.9.1985, M.K. Janarthanam 82936 (MH).

MADHYA PRADESH: Central India, Oct. 1867, G. King 96 (CAL); C. Provinces, Udaipur State, Dharm Jaigarh, 1300 ft., 19.3.1940, H.F. Mooney 1277 (DD); Bailadila, 9.10.1940, H.F. Mooney 1519 (DD); Bastar dist., Kanker, Rajbandha tank, 17.11.1958, K. Subramanyam 7162 (MH); Satna dist., Satna, Paddy fields, 20.9.1959, K.M. Sebastine 8899 (MH).

MAHARASHTRA: Nagpur dist., Ambazeri tank, 18.11.1957, K. Subramanyam 4682, 4683 (MH), 22.8.1962, Ku. U.R. Nafday 59 (BSI, CAL); Ratnagiri dist., Sherla to Padlos, Banda, 14.8.1971, B.G. Kulkarni 131657 (BSI).

MEGHALAYA: Khasiya mountains, J.D. Hooker & T. Thomson (CAL, Acc. no. 330246; MH Acc. no. 61486); Sohra, Khasia, 4000 ft., 26.11.1871, C.B. Clarke 15164B (CAL); Mamloo, Khasia, 4000 ft., 15.10.1886, C.B. Clarke 45291 (CAL); Mowlong, 2500 ft., 24.9.1886, C.B. Clarke 45063 (DD); Mynkrem Forest, 5.11.1938, G.K. Deka 18537 (ASSAM); Pynursla, 4500 ft., 17.10.1945, N.L. Bor s.n. (DD, Acc. no. 96975), 25.8.1956, G. Panigrahi 2922 (CAL); Cherrapunji-Mawmluh, 27.9.1956, G. Panigrahi 3516 (CAL); Mawsyram, 18.9.1962, S.L. Kapoor & party 71706 (LWG); Barapani, 29.10.1986, M.K. Janarthanam 83031 (MH); Cherrapunjee, Mawsmai, 30.10.1986, M.K. Janarthanam 83033 (MH).

ORISSA: Ganjam, Chatrapur, Dec. 1889, J.S. Gamble 21560 (BSI, DD); Mahendragiri hills, 1904, C.E.C. Fischer s.n. (CAL); Talcher State, Paipal Dalki, 300 ft., Dec.

1940, H.F. Mooney 1644 (DD); Sambalpur, 2.10.1949, H.F. Mooney 3689 (DD); Majhiguda, 620 m, 18.12.1962, G.V.S. Rao 30342 (ASSAM).

TAMIL NADU: Kodaikanal, Shenthetty Kanal, 20.9.1905, C.A. Barber 7531 (MH); Shenbaganur, Kodaikanal, Rev. L. Anglade 1794 (CAL); Shevaroy's, Green hills, Jan. 1941, E. Barnes s.n. (DD); Pudukkottai dist., Narthamalai, 23.9.1964, K. Ramamurthy 25944 (MH); Ramanathapuram dist., Sivaganga, Esani Forest, 16.12.1964, K. Ramamurthy 22732 (MH), 22733 (CAL, MH); Shevaroy's, Yercaud, Brooklyn, 29.4.1966, A.V.N. Rao 27499 (CAL, MH); Pudukkottai dist., Siddannavasal, 2.2.1978, K. Ramamurthy 53737 (MH); Chengalpattu dist., Sunnambukkulum, Tangachoolaimedu lake, 10.1.1986, M.K. Janarthanam 82974 (MH); Vandalur, Anna Zoological Park, 15.1.1986, M.K. Janarthanam 82975 (MH); North Arcot dist., Veerambakkam, 16.1.1986, M.K. Janarthanam 82978 (MH).

UTTAR PRADESH: Mirzapur, Wyndham fall, 16.7.1965, O.P. Misra 9733 (CAL).

W. BENGAL: N. Bengal, Poliabaree & Titallya, 9/1868, S. Kurz s.n. (CAL, Acc. no. 330282); Purulia, Manbhum, 1886, Campbell s.n. (CAL, Acc. no. 330254); Birbhum Dist., Taltar, 7.9.1949, K. Biswas 4243 (CAL); Amankuthir, Oct. 1964, B.P. Duha s.n. (CAL, Acc. no. 2334 p.p.); Vicary s.n. (CAL, Acc. no. 330249, 330277); Nov. 1878, King s.n. (CAL, Acc. no. 330281); 31.10.1900, N. Gill s.n. (CAL, Acc. no. 330248).

Loc. (?). Nov. 1856, Beddome 100 (CAL).

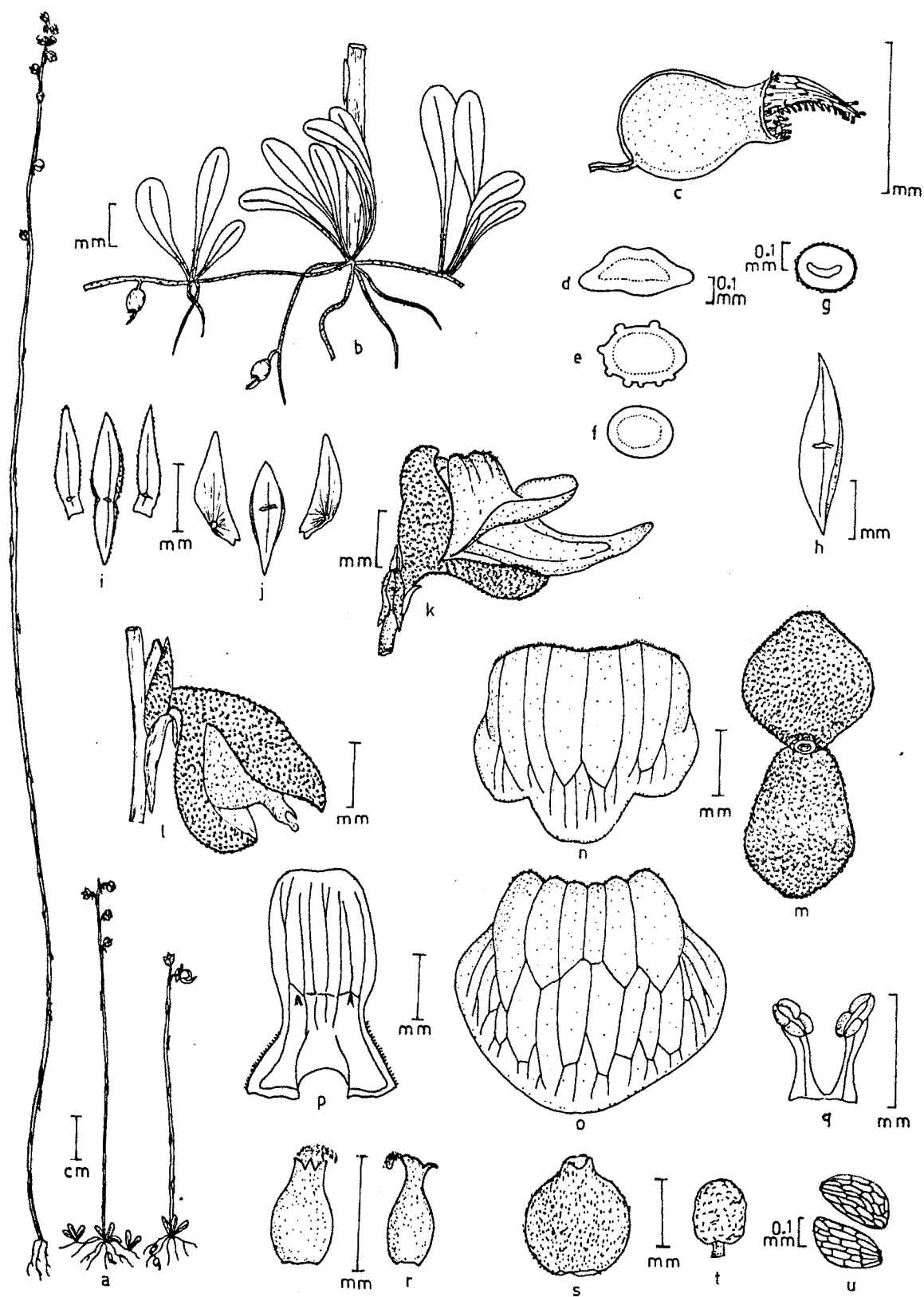


Fig. 11. *Utricularia caerulea* L.: a. Plants; b. Foliar organs at scape base and on stolons; c. Trap; d, e, f. T.S. of scape; g. T.S. of pedicel; h. Scale; i, j. Bracts & bracteoles; k. Flower; l. Fruit; m. Calyx; n, o. Corolla - lower lip; p. Corolla - upper lip; q. Stamens; r. Pistil - different views; s. Capsules; t. Placenta; u. Seeds.



Photo 5. A. *Utricularia caerulea* L., B. *U. recta* M.K. Janarthanam, C. *U. minutissima* Vahl, D & E. *U. cecillii* Taylor, F. *U. uliginosa* Vahl, G. *U. lazulina* Taylor



Photo 6. A. *Utricularia furcellata* Oliver, B. *U. striatula* Smith, C. *U. caerulea* L., D. *U. roseopurpurea* Stapf ex Gamble

9. *Utricularia cecillii* Taylor in Proc. Indian Acad. Sci. (Plant Sci.) 93B: 99. 1984. - HOLOTYPE: INDIA. Karnataka, S. Kanara, Kulshekar, Taylor 18020 (K, Photo !)
(Photo 7).

Herbs; rhizoids up to 2 cm long, 0.3-0.4 mm thick, tapering towards apex, glandular, branches up to 3 mm long, papillose; stolons up to 4 cm long, c 0.2 mm thick, glandular. Foliar organs up to 10 x 2 mm, narrowly obovate, solitary at each stolon node, 3-nerved, rounded at apex. Traps up to 1 mm across, subglobose, subdimorphic, on vegetative organs; stalk distally thickened or even throughout; mouth basal; appendages 2, subulate, glandular. Racemes up to 18 cm long, c 0.7 mm thick, erect, rarely branched, angular, grooved, 1-6-flowered; scales up to 2 mm long, basifixed, ovate-deltoid, 3-nerved, rarely 1-nerved, acute at apex; bracts c 1.8 mm long, basifixed, ovate-deltoid, 1, 3 or 5-nerved, acute at apex; bracteoles shorter than bract, subulate, rarely 1-nerved; flowers up to 9-15 mm long; pedicels 2-9 mm long, erect at anthesis and spread in fruit, winged. Calyx-lobes unequal; upper lobe 3-6 x 3-4.5 mm, broadly ovate, margin dentate, acute at apex; lower lobe 3-4 x 2.5-3.5 mm, ovate, bi- or tridentate at apex. Corolla deep violet; upper lip c 7 x 5 mm, obovate, constricted at middle, crested near constriction, margin hairy near base, rounded or rarely emarginate at apex; lower lip 8-11 x 8-10 mm, galeate, hairy at throat, gibbous at base, rounded to emarginate at apex. Stamens 1.5-1.8

mm long; filaments strap-shaped, curved; anther thecae distinct. Pistil c 1.8 mm long; ovary ovoid, compressed; style flat; stigma 2-lipped, semiorbicular, rarely truncate. Capsules 3.5-4 x 2.5-3 mm, ovoid, dehisce by a single vertical slit; placenta 2-2.5 x 1.5-2 mm, ovoid, compressed. Seeds 0.2-0.35 mm long, obovoid; hilum terminal; testa reticulate, cells elongate, polygonal, intercellular space distinct. (Fig. 12; Photo 5D, 5E).

Fl. & Fr.: August and September.

Local name: Malayalam - Paara poo, Krishna poo.

Ecology: Wet or water logging places over laterite rocks; from sea-level to 700 m.

Distribution: Endemic to S. Kanara district of Karnataka and Kasaragod district of Kerala. (Map 5).

Pollen: 4-colporate, 28 x 31 μ , Taylor 18020 (K). (Taylor l.c.).

Notes: Utricularia cecilii Taylor is allied to U. uliginosa Vahl and can be easily differentiated by its large flowers, broader upper lip of corolla, obovoid seeds and intercellular spaces in testa. Also allied to U. reticulata Smith, but can be differentiated by its erect inflorescence, 3-nerved foliar organs, subequal calyx-lobes, uniformly membranous capsule, absence of striations within the testa cells, and presence of intercellular spaces. In U. cecilii the floral parts in cleistogamous flowers are crowded and much reduced: Calyx-lobes minute, 1-nerved; corolla cup-like or absent; anthers indistinct from filaments,

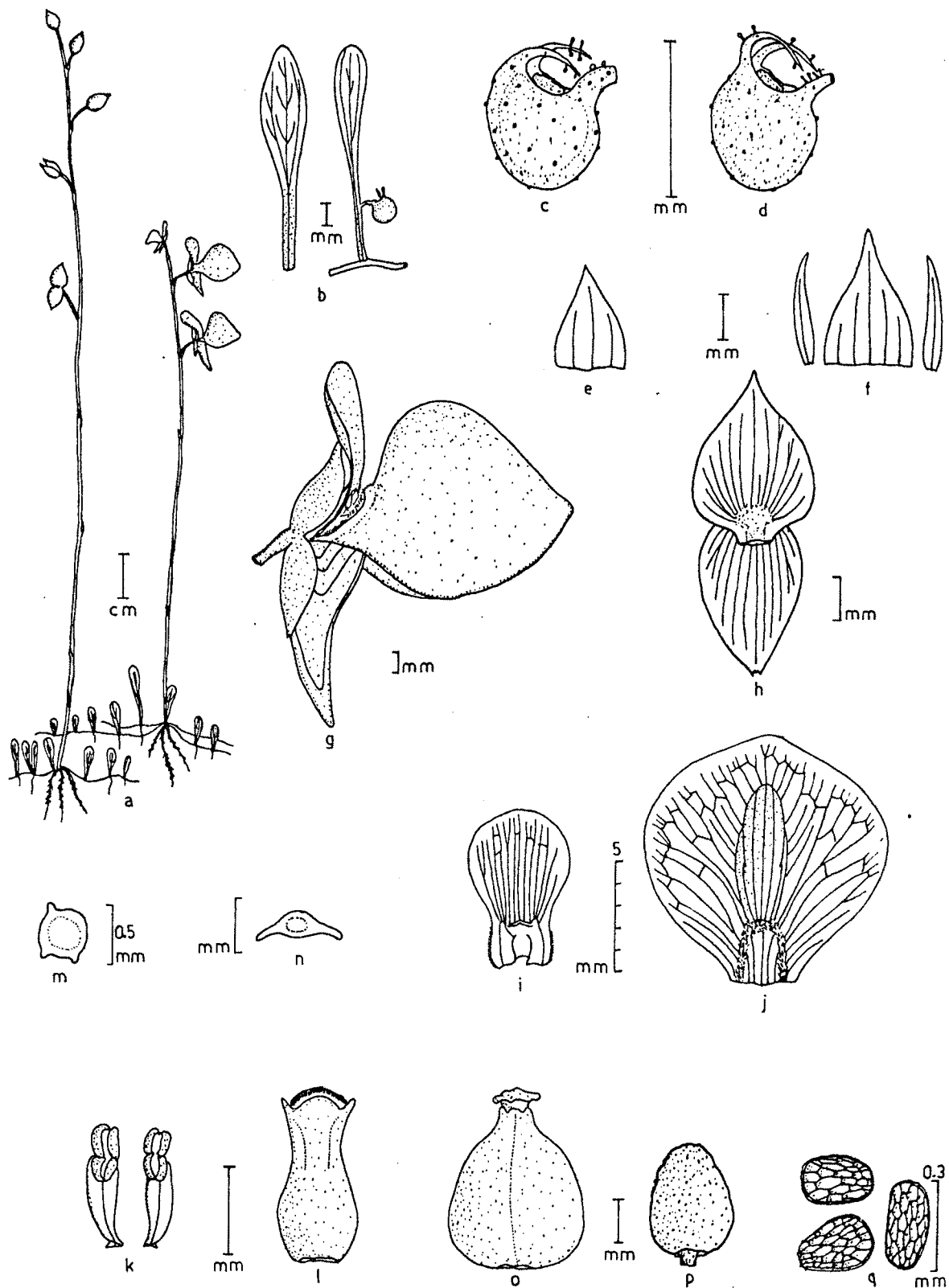


Fig. 12. *Utricularia cecillii* Taylor: a. Plants; b. Foliar organs; c, d. Traps; e. Scale; f. Bract & bracteoles; g. Flower; h. Calyx; i. Corolla - upper lip; j. Corolla - lower lip; k. Stamens; l. Pistil; m. T.S. of scape; n. T.S. of pedicel; o. Capsule; p. Placenta; q. Seeds.

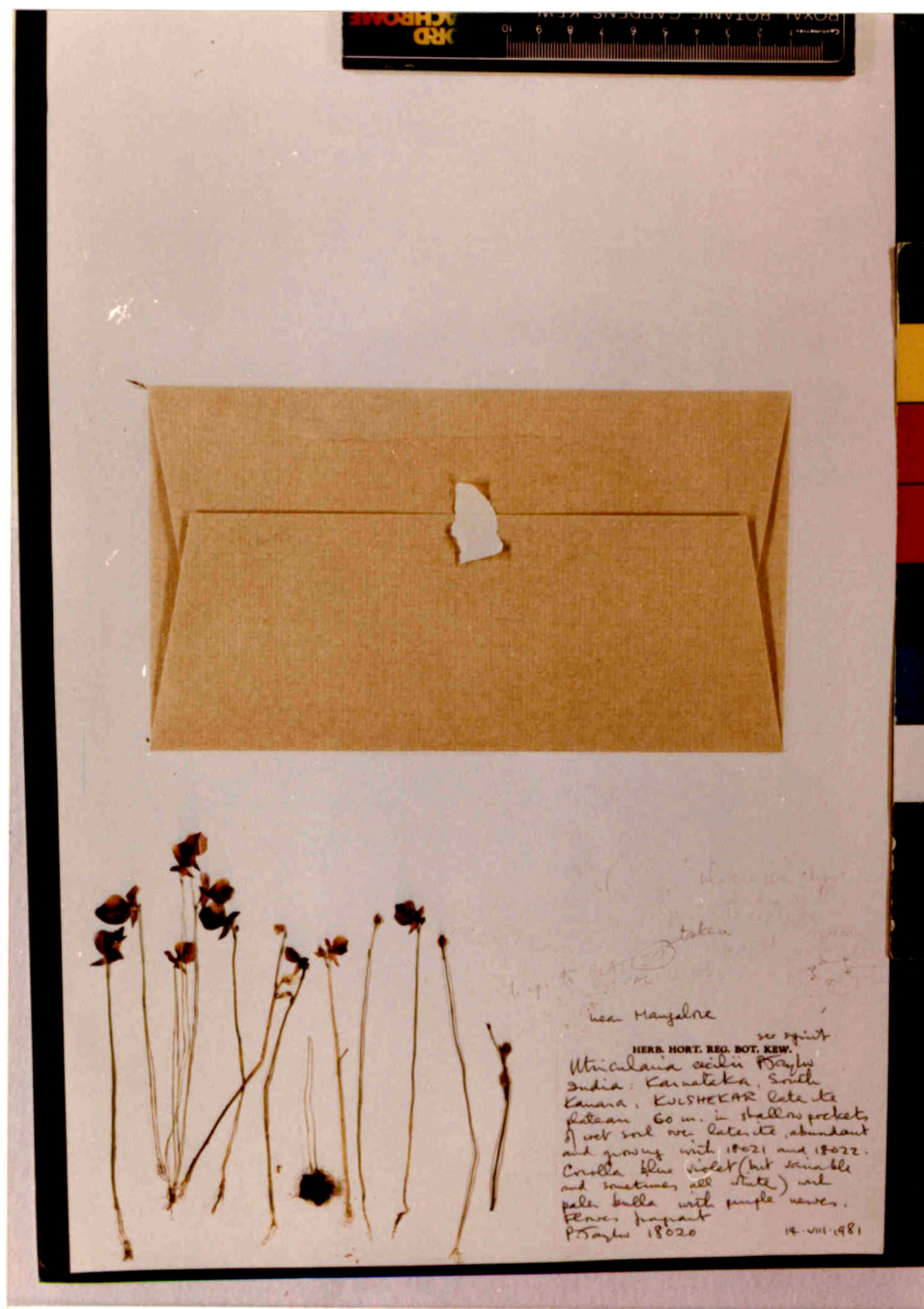


Photo 7. *Utricularia cecilia* Taylor (Holotype - K).

and pistil rudimentary.

Two types of glands are seen on the traps of this species. Traps on foliar organs have glandular hairs and traps present elsewhere have sessile, globose glands.

U. cecilii grows abundantly on laterite rocks, forming a violet 'carpet' during flowering season, and can easily be recognised even from a moving bus. The plant is well known to the local people of Northern Kerala as 'Krishna poo' or 'Paara poo', as it is used for decoration during the festival season of 'Singha maasam.'

Specimens examined:

KARNATAKA: S. Kanara, Kulshekar, Taylor 18020 (JCB), 19.8.1986, M.K. Janarthanam 82913 (MH).

KERALA: Kasaragod dist., Beemanadi, 250 m, 27.9.1982, R. Ansari 74330, 74334 (MH), Periya, 20.8.1985, M.K. Janarthanam 82920 (MH), Mulleriyar, 21.8.1985, M.K. Janarthanam 82921 (MH), Beemanadi, 22.8.1985, M.K. Janarthanam 82926 (MH).

10. *Utricularia exoleta* R. Br. Prodr. 430. 1810; Clarke in Hook.f. Fl. Brit. India 4: 329. 1884; Trimen, Handb. Fl. Ceylon 3: 268. 1895; Woodrow in J. Bombay Nat. Hist. Soc. 12: 175. 1898; Wood in Rec. Bot. Surv. India 2: 124. 1902; Prain, Bengal Pl. 2: 781. 1903 (2: 582. 1963 repr. ed.) & in Rec. Bot. Surv. India 3: 254. 1905; Gage in Rec. Bot. Surv. India 3: 86. 1904; Cooke, Fl. Bombay 2: 317. 1905 (2: 390. 1958 repr. ed.); Duthie, Fl. Gangetic Plain

2: 166. 1911 (2: 39. 1960 repr. ed.); Rama Rao, Fl. Pl. Travancore 294. 1914; Haines, Bot. Bihar Orissa 3 & 4: 645. 1922 (2: 676. 1961 repr. ed.); Gamble, Fl. Madras 980. 1924 (2: 689. 1957 repr. ed.); Santapau in J. Bombay Nat. Hist. Soc. 49: 218. 1950; Deb in Bull. Bot. Surv. India 3: 342. 1961; Subramanyam, Aquatic Angio. 38. 1962; Gandhi in Saldanha & Nicolson, Fl. Hassan 564. 1976; Taylor in Steenis, Fl. Males. I. 8: 294. 1977; Srivastava in J. Econ. Tax. Bot. 4: 190. 1983; Rani & Matthew in Matthew, Fl. Tamilnadu Carnatic 3: 1114. 1983; Singh, Fl. Bansk. Rajasthan 172. 1983; Sharma et al. Fl. Karnataka 125. 1984; Mukerjee, Fl. Pachmarhi Bori Res. 216. 1984; Ugemuge, Fl. Nagpur 273. 1986. - HOLOTYPE: AUSTRALIA. R. Brown (BM, Photo !). (Photo 8).

Utricularia diflora Roxb. ex Clarke in Hook.f. Fl. Brit. India 4: 329. 1884 pro. syn.

Utricularia biflora Roxb. Fl. Ind. 1: 144. 1820 & ed. 2. 1: 143. 1832. - TYPE: INDIA. Bengal, Roxburgh (BM, Photo !)

Utricularia diantha Roxb. ex Roem. & Schultes, Mant. 1: 169. 1822; Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849 & Ic. t. 1569. 1850; Oliver in J. Proc. Linn. Soc., Bot. 3: 176. 1859; Drury, Handb. Ind. Fl. 2: 120. 1866. - TYPE: as U. biflora Roxb.

Utricularia roxburghii Spreng. Syst. 1: 52. 1825. - TYPE: as U. biflora Roxb.

Utricularia pterosperma Edgew. in Proc. Linn. Soc. London 1: 352. 1848. - TYPE: Bengal, Edgeworth (K).



54071

Utricularia saharunporensis Royle ex Oliver in J. Proc. Linn. Soc., Bot. 3: 176. 1859, pro. syn.

Utricularia elegans Wall. ex Oliver in J. Proc. Linn. Soc., Bot. 3: 176. 1859, pro. syn.

Utricularia gibba L. subsp. exoleta (R. Br.) Taylor in Mitt. Bot. Staatssamml. Muenchen 4: 101. 1961 & in Kew Bull. 18: 204. 1964; Abraham & Subramanyam in Proc. Indian Acad. Sci. 62B: 98. 1965; Hara, Fl. East Himal. 300. 1966; Rau in Bull. Bot. Surv. India 10: 57. 1968; Ramasamy & Razi, Fl. Bangalore 547. 1973; Basak in Bull. Bot. Surv. India 17: 100. 1975 (1978); Srivastava, Fl. Gorakhpur. 233. 1976 ("U. gibbosa L. ssp. exoleta"); Babu, Herb. Fl. Dehra Dun 367. 1977; Shah, Fl. Gujarat 1: 514. 1978; Varma, Fl. Bhagalpur 286. 1981; Raghavan et al. in Rec. Bot. Surv. India 21: 63. 1981; Manilal & Sivarajan, Fl. Calicut 208. 1982; Deb, Fl. Tripura 2: 304. 1983.

Utricularia khasiana Joseph & Mani in Bull. Bot. Surv. India 25: 192. 1983 (1985); Joseph & Joseph, Insect. Pl. Meghalaya 16. 1986. - HOLOTYPE: INDIA. Meghalaya, Shillong, Joseph 76944 (ASSAM ! to be deposited in CAL).

Herbs; rhizoids usually absent, if present up to 5 cm long, c 1 mm thick at base, fusiform, tapering towards apex, branches botryform; stolons up to 20 cm long, c 0.2 mm thick, profusely branched. Foliar organs up to 1 cm long, simple or 1-3 times dichotomously divided from base or at a short distance from base; ultimate leaf segments few, slightly compressed or terete, sparsely setulose along

margins. Traps up to 1.5 mm across, obliquely ovoid, replacing foliar segments or rarely on rhizoids; stalk evenly thickened; mouth lateral, oblique; appendages usually 2- or rarely more. Racemes 4-15 cm long, erect, solitary or fasciculate, glabrous, 1-3-flowered; scales absent or rarely 1-2, c 0.6 x 1 mm, basifixed, obovate to semiorbicular, truncate or slightly 3-lobed at apex; bracts 0.8-1 x 1-1.3 mm, transversely oblong, 5-nerved, truncate or denticulate at apex; flowers up to 7 mm long; pedicels 2-8 mm long, terete, erect or suberect. Calyx-lobes subequal, obovate to ovate, rounded or truncate at apex; upper lobe c 1.4 x 1.3 mm (c 3 x 3 mm in fruit); lower c 1.3 x 1.3 mm (c 2.5 x 2.5 mm in fruit). Corolla yellow; upper lip c 3 x 3 mm, orbicular to ovate, truncate or rounded at apex; lower lip c 2.7 x 2.5 mm, orbicular to broadly ovate, bigibbous at base, rounded, truncate or rarely 3-lobed at apex; spur as long as lower lip, conical, glandular within, obtuse or notched at apex. Stamens c 1 mm long; filaments flat, curved; anther thecae distinct. Pistil c 1 mm long; ovary globose; style small; stigma 2-lipped, lower lip larger and semiorbicular, upper lip obsolete or denticulate. Capsules c 3 mm across, globose, bivalvate; placenta c 2 mm across, globose, glabrous, pitted. Seeds c 1 mm wide, lenticular, with a broad, irregular corky wing; hilum prominent; testa cells arranged radially. (Fig. 13).

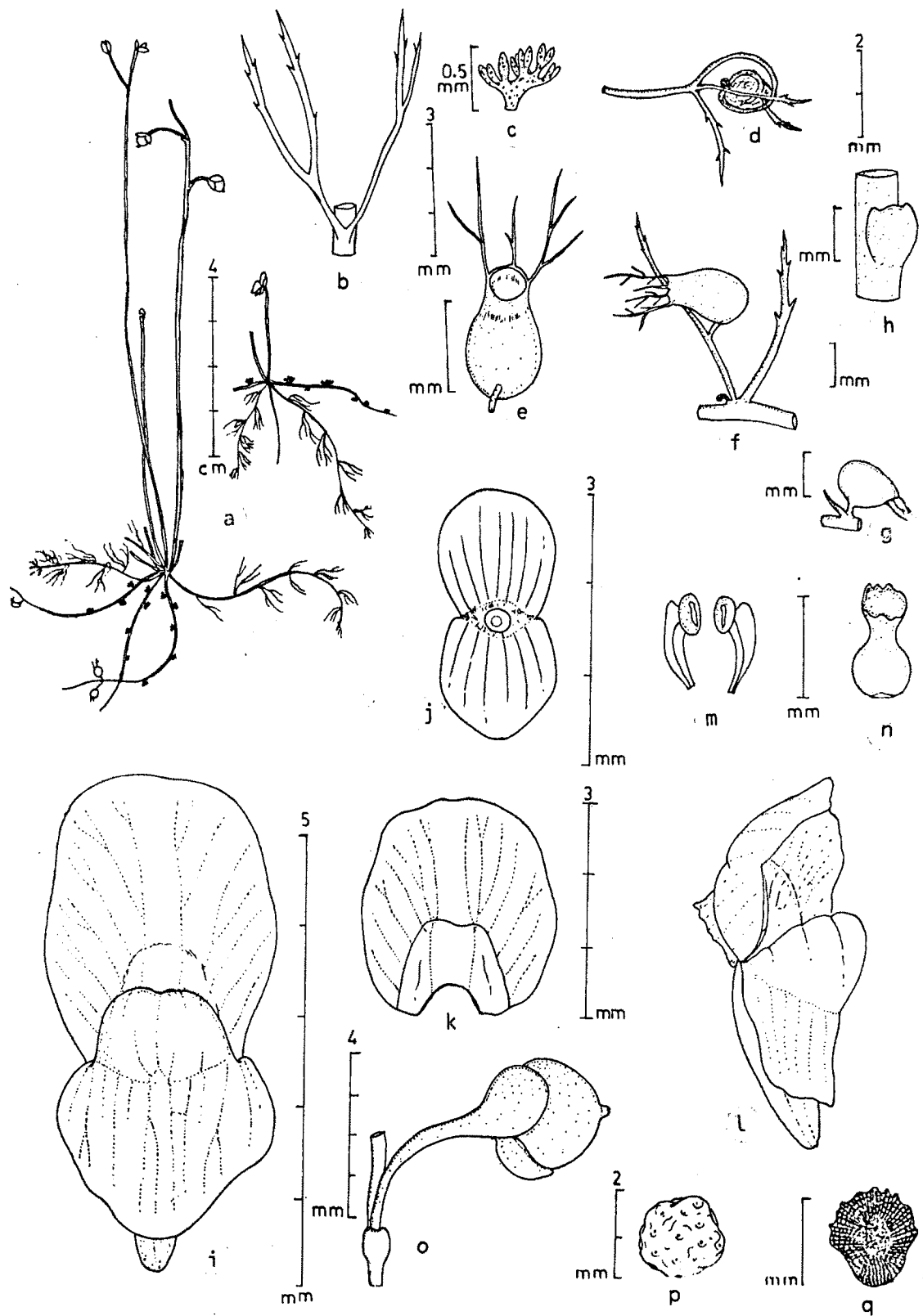


Fig. 13. *Utricularia exoleta* R. Br.: a. Plants; b. Foliar organ; c. Rhizoidal branches; d. Stolon - circinate vernation; e. Trap; f, g. Trap along with foliar organs; h. Scale; i. Flower; j. Calyx; k. Corolla - upper lip; l. Corolla - lateral view; m. Stamens; n. Pistil; o. Fruit; p. Placenta; q. Seed.

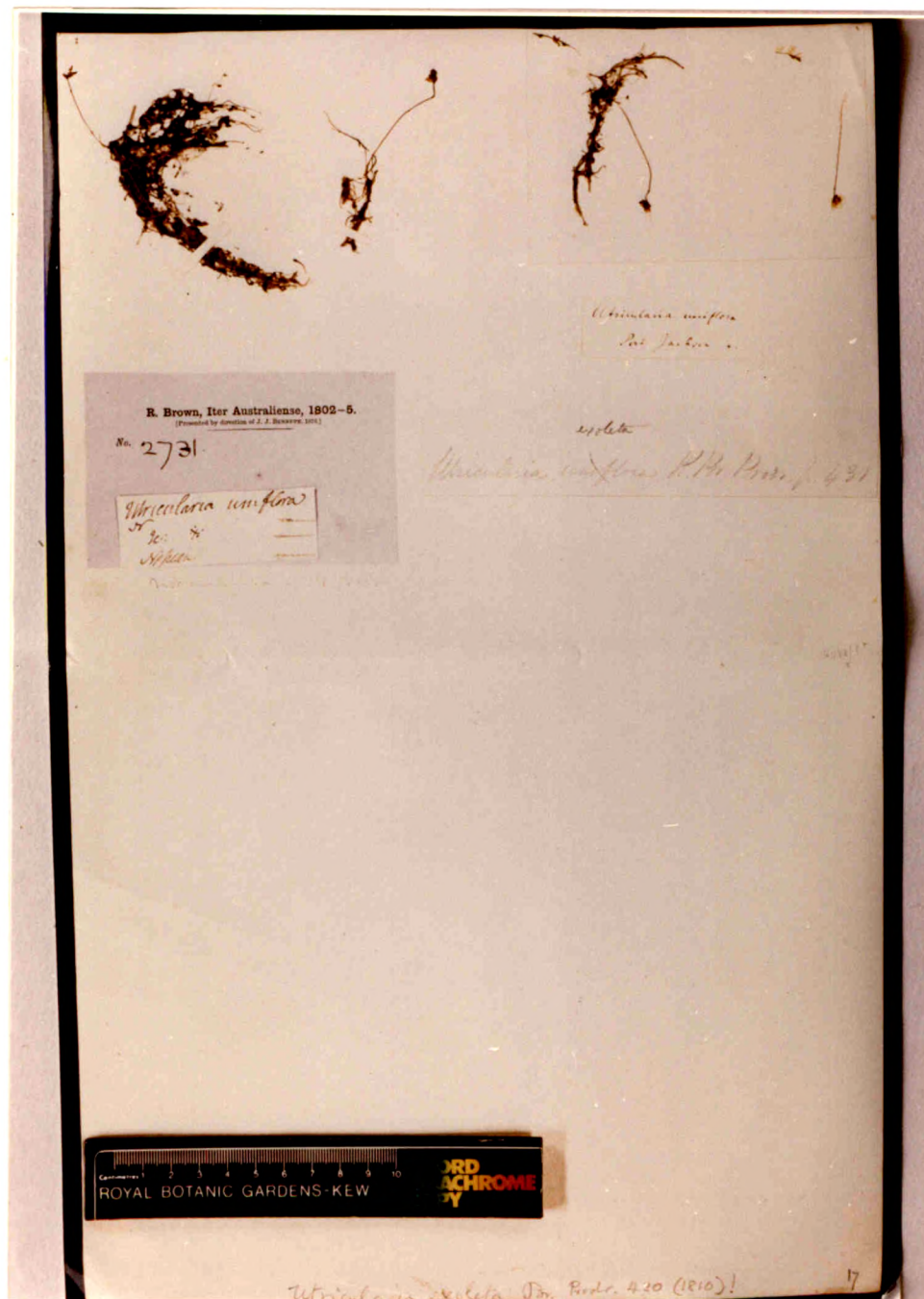


Photo 8. *Utricularia exoleta* R. Br. (Holotype - BM).

Fl. & Fr.: January-May with a peak in February and March.

Local name: Bengali - Chota-Janjee.

Ecology: Submerged floating in shallow water and in swamps or rooted in mud; from sea level to 1700 m, often growing with U. aurea Lour.

Distribution: Tropical Africa, to Japan and Northern Australia; in India distributed throughout the country including Andaman & Nicobar Islands (Map 5).

Pollen: Isopolar, 11-12-colporate, synorate, 11-12-lobed in polar view, spindle shaped in equatorial view. Longiaxe pollens 40-45 x 30-33 μ ; breviaxe pollens 28 x 45 μ . (Thanikaimoni 1966).

Notes: Utricularia khasiana Joseph & Mani was described on the basis of vegetative materials collected from Ward lake, Shillong. According to the authors the plant had never set flowering during their many years of observation. The structure and ramification of foliar organs, and the shape and position of traps as well as their affinity to dry black, suggest that the plant is only a variable form of U. exoleta R. Br. The circinate vernation in this plant might be due to the cold climate (Turions of temperate plants like U. minor L. are comparable). Absence of flowering in these materials may be due to the alteration in the photoperiodism by the uneven climate prevailing over the region. U. khasiana Joseph & Mani is therefore included in U. exoleta R. Br.

The seeds of U. exoleta are unique among Indian Utricularias. The species can be easily identified with the help of its seeds which are lenticular and broadly corky winged. This is the only aquatic bladderwort recorded from Andaman & Nicobar Islands.

Specimens examined:

ANDAMAN & NICOBAR ISLANDS: Nicobar Islands, Kamorta, 2/1875, S. Kurz s.n. (CAL, Acc. no. 330065).

ANDHRA PRADESH: Visakhapatnam dist., Arakuvalley, 9.6.1952, D. Daniel Sunderaraj 21390 (MH); Kurnool dist., Srisaïlam, 13.7.1963, J.L. Ellis 16849 (CAL, MH), Pathalaganga, Nallamalais, 25.3.1965, J.L. Ellis 23759 (MH), West of Srisaïlam, Nallamalais, 27.3.1965, J.L. Ellis 23788 (MH); Anantapur dist., Alur kona, 28.10.1982, 350 m, T. Pullaiah 926 (MH).

BIHAR: Champaran dist., Manguraha, 15.4.1963, K. Thothathri 10093 (CAL).

KARNATAKA: N. Kanara, Simusji, Feb. 1893, Cooke's herbarium, s.l. 22786 (BLAT); S. Kanara, Karikal, 16.3.1915, s.l. 11959 (MH); Dharwar, Hanapur Tank - Tadas, Mar. 1917, s.l. 2373 (BLAT); Devarayh, 1800 ft., Oct. 1918, L.J. Sedgwick 4457 (BLAT); Bannerghatta, 10.6.1953, H.C. Govindu s.n. (MH, Acc. no. 96093); Mysore dist., Gudihattikere, Ketedevargudi, 23.4.1962, A.S. Rao 80284 (BSI, CAL); Dyana-shram, Bannerghatta, 2.12.1978, Cecil J. Saldanha & K.P. Sreenath KFP 4850 (CAL); Kolar, 10.7.1979, P. Prakash KFP 8318 (CAL).

KERALA: South Malabar, Kalladikad, 26.2.1911, C.E.C. Fischer 2625 (CAL); Tenmalai, 22.11.1961, K.N. Subramanian 77061 (BSI); Kottayam dist., Pamba, 25.6.1968, D.B. Deb 30377 (MH); Trivandrum dist., Pulimath, 28.2.1979, M. Mohanan 59430 (CAL, MH); Kasaragod, 23.8.1985, M.K. Janarthanam 82930 (MH).

MADHYA PRADESH: Sahdol, Village Tala, 3.1.1959, A. Singh & party 54735 (LWG); Shivapuri, Chandpata, 30.1.1959, A. Singh & party 56052 (LWG); Bastar, Kanker, 6.2.1961, N.P. Balakrishnan & A.N. Henry 11872 (MH); Bilaspur, Korba, 17.4.1965, G. Panigrahi & C.M. Arora 8685 (CAL).

MAHARASHTRA: Poona, March-April, 1867, G. King 36 (CAL); Lonavla, Valwan dam, 30.9.1964, B. Venkata Reddi 100946 (BSI).

MEGHALAYA: Shillong, Ward lake, 20.8.1960, G.K. Deka 21867 (ASSAM), 6.10.1980, J. Joseph 76945 (ASSAM), 23.9.1981, K.M. Joseph 79366 (ASSAM), 27.10.1986, M.K. Janarthanam 83028 (MH).

ORISSA: Bhitarkanika R.F., 6.2.1961, G. Panigrahi 23753 (ASSAM).

RAJASTHAN: Kotah, Umedganj, 12.6.1963, R.S. Gupta s.n. (BSD, Acc. no. 29171).

TAMIL NADU: Tinnevely, Ambasamudram, 23.5.1899, C.A. Barber 281 (MH); Tiruchirappalli dist., Thiruvudai-sholai, 17.2.1959, K. Subramanyam 7779 (CAL, MH); Chengalpattu dist., Neithavoyal, 2.6.1986, M.K. Janarthanam 82983 (MH).

UTTAR PRADESH: Gangetic plains, T. Thomson s.n. (MH, Acc. no. 69354); Mirz^apur, 8.2.1961, U.C. Bhattacharya 12888 (BSD); Anarkali Tal, Bahraich, 15.2.1963, C.L. Malhotra 23693 (BSD, CAL); without loc. 11.3.1964, G. Panigrahi 2827 (CAL); Dehra Dun, New Forest, 18.8.1970, Ram Dayal 21769 (DD).

W. BENGAL: Lower Bengal, Seepore, 2/1867, S. Kurz s.n. (CAL, Acc. no. 330056); Jahanabad canal, 10.3.1902, J.D. Nusker 3 (CAL); Bankura, Bishnupur, Koch Birai, 25.2.1965, M.N. Sanyal 580 (CAL); Malda, Vicary s.n. (CAL, Acc. no. 330055).

Without loc.: Wight 2419 (CAL).

11. *Utricularia furcellata* Oliver in J. Proc. Linn. Soc., Bot. 3: 189. 1859; Drury, Handb. Ind. Fl. 2: 126. 1866; Clarke in Hook.f. Fl. Brit. India 4: 334. 1884; Smith in Rec. Bot. Surv. India 4: 403. 1913; Basak in Bull. Bot. Surv. India 17: 104. 1975 (1978); Joseph & Joseph, Insect. Pl. Meghalaya 34. 1986. - LECTOTYPE: Khasya, Bogapanee, 27.10.1950, J.D. Hooker & T. Thomson 2534 (K, Photo !). (Photo 9).

Utricularia furcellata Oliver var. *minor* Clarke in Hook.f. Fl. Brit. India 4: 334. 1884. - SYNTYPES: Temp. Sikkim, Lachen, J.D. Hooker; Khasia Mountains, Boga pani, J.D. Hooker (K, Photo !).

Herbs; rhizoids up to 2 cm long, simple or sparsely branched, glandular; stolons absent. Foliar organs with

pseudopetioles up to 12 mm long, rosulate, absent from vegetative organs; expanded portion 1-5 x 1.5-6 mm, orbicular or suborbicular, veins dichotomous. Traps 1-1.5 mm across, on rhizoids, obliquely ovoid, glandular, stalked; mouth lateral; appendages of radiating multicellular hairs from expanded lip. Racemes up to 9 cm long, often glandular at base, 1-5-flowered; bracts c 0.8 mm long, medifixed, lanceate, constricted near base, truncate at base, acute at apex; bracteoles c 0.8 mm long, similar to bracts but slightly curved; flowers c 5 mm long; pedicels c 4 mm long, terete, erect in flower, spread in fruit. Calyx-lobes unequal, papillose; upper lobe 1.5-2 x 2.3-3.5 mm, 5-nerved, emarginate at apex; lower lobe c 1 mm long, oblong, rounded or dentate at apex, nerves absent. Corolla white or pink, papillose, yellow in throat; upper lip c 1.2 x 2 mm, deltoid, 2-nerved, emarginate at apex; lower lip c 2.5 x 3.5 mm, 4-lobed, hairy in throat, slightly raised at base; spur c 3 mm long, glandular within, acute at apex. Stamens c 0.8 mm long; filaments curved; anther thecae distinct. Pistil c 1 mm long; ovary ovoid, papillose; style distinct; stigma 2-lipped, lower lip recurved, upper lip obsolete or represented by a small projection. Capsules c 2 mm across, obliquely ovoid, attached to upper calyx-lobe at base, strongly keeled on ventral surface, dehisce longitudinally on ventral side; placenta c 0.7 mm across, subglobose. Seeds c 0.5 mm long, ovoid to ellipsoid,

attached tangentially to placenta, glochidiate; hilum lateral. (Fig. 14; Photo 6A).

Fl. & Fr.: August-November.

Ecology: Along dripping rocks and moss-covered tree trunks above 1500 m.

Distribution: Endemic to Khasia hills and mountains of Sikkim and Darjeeling (Map 5).

Pollen: Isopolar, tetracolporate, circular in polar view, elliptic in equatorial view, 40-45 x 48-50 μ . (Thanikaimoni 1966).

Notes: Utricularia furcellata Oliver is closely related to U. striatula Smith. Cave (in a letter addressed to Dr. Prain - attached to sheet no. 330322 at CAL) observed that ".....they can be distinguished at a glance at a distance of a yard, the flower of the former [U. orbiculata Wall. (= U. striatula Smith)] looking almost white from the mixture of yellow and pink, and the colour of the latter (U. furcellata Oliver) being purple..... U. furcellata seems to prefer the higher elevation and to draw the line at 7000'....."

However they can be clearly differentiated as tabulated below:

	<u>U. striatula</u> Smith	<u>U. furcellata</u> Oliver
1. Stolons	Present	Absent
2. Foliar organs	At scape base and on stolons	At scape base

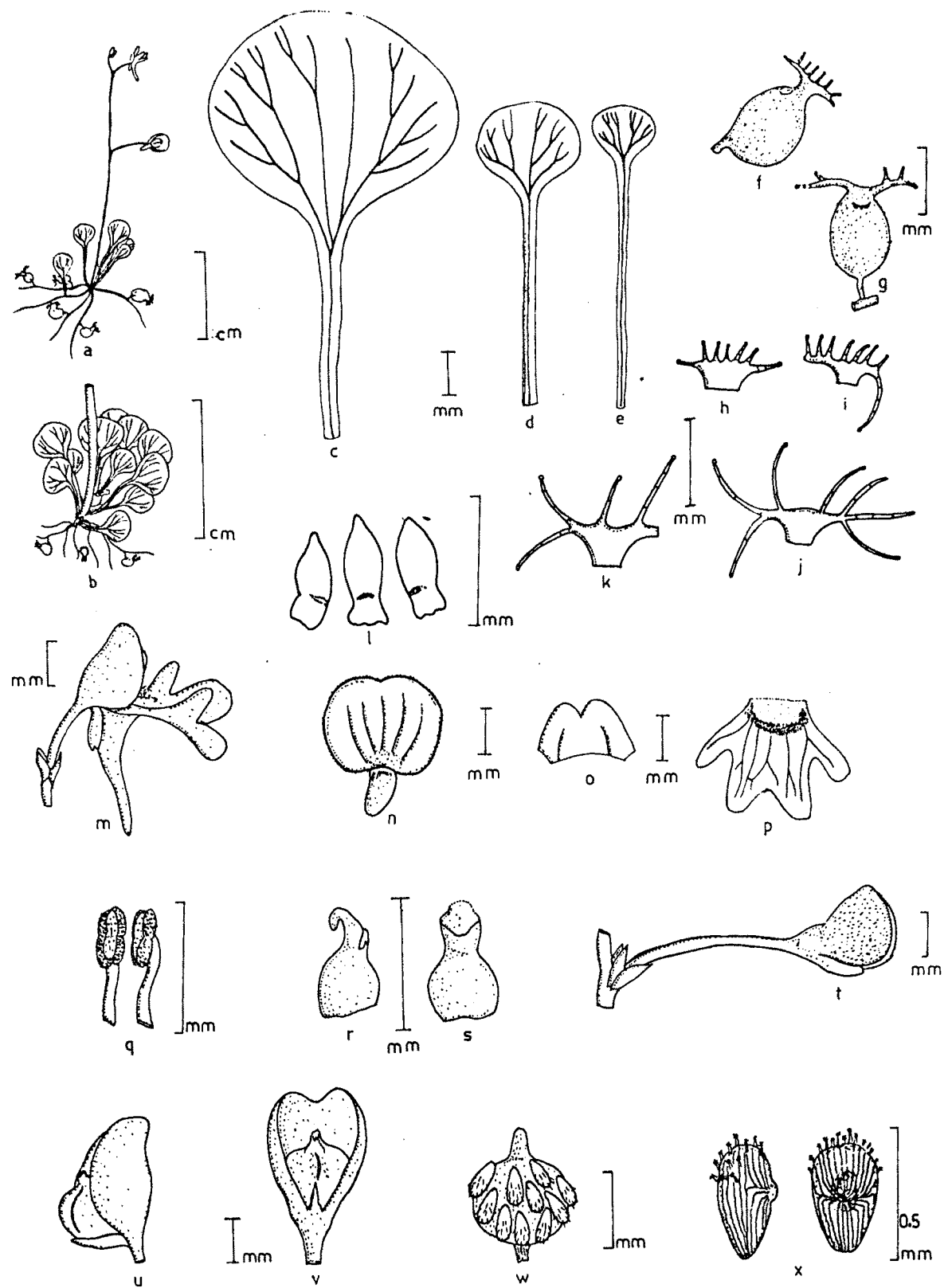


Fig. 14. *Utricularia furcellata* Oliver: a. Plant; b. Scape base; c, d, e. Foliar organs; f, g. Traps; h, i, j, k. Appendages of Traps; l. Bract & bracteoles; m. Flower; n. Calyx; o. Corolla - upper lip; p. Corolla - lower lip; q. Stamens; r. Pistil - lateral view; s. Pistil - adaxial view; t, u, v. Fruits; w. Placenta with seeds; x. seeds.

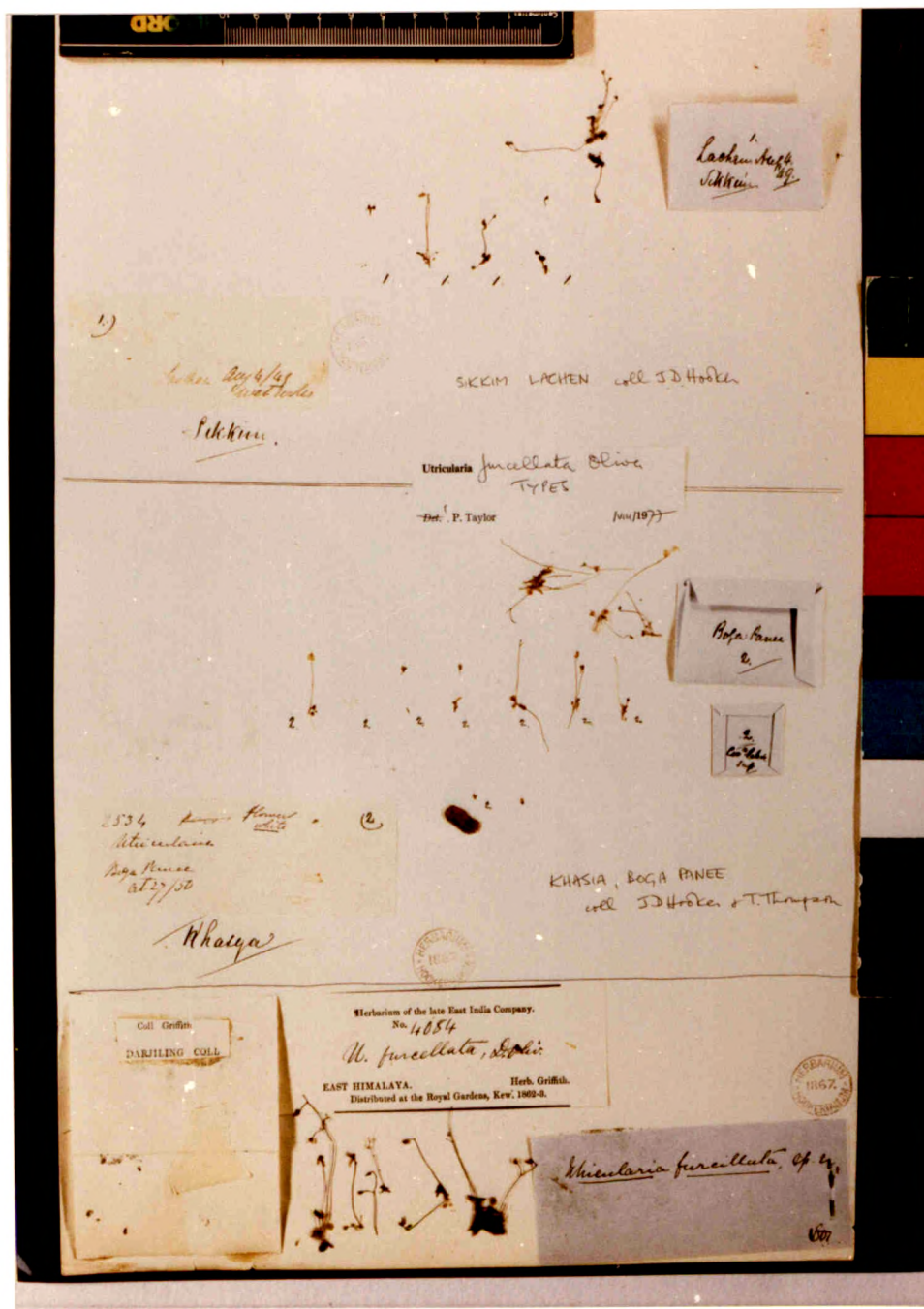


Photo 9. *Utricularia furcellata* Oliver ('2' lectotype selected - K).

3. Lower lip	3- or 5-	4-lobed
of corolla	lobed	
4. Capsule	Not keeled	Keeled
5. Seeds	Radially attached to	Tangentially attached
	placental; hilum ter-	to placental; hilum
	minal; glochidia	lateral; glochidia ⁱ
	present all around	present, but absent
		around hilum.

Specimens examined:

MEGHALAYA: Upper Shillong, 26.11.1956, G. Panigrahi 4741 (ASSAM); Shillong-Pynursula Road, 20th mile, 2.8.1980, J. Joseph 76932 (ASSAM); Upper Shillong, Elephant falls, 28.10.1986, M.K. Janarthanam 83029 (MH).

W. BENGAL: Darjeeling, 7,000-9,000 ft., 9.9.1903, G.H. Cave s.n. (CAL, DD).

12. *Utricularia graminifolia* Vahl, Enum. Pl. 1: 195. 1804; Gamble, Fl. Madras 981. 1924 (2: 690. 1957 repr. ed.); Fyson, Fl. S. Ind. Hill St. 1: 437. 1932 & 2: t. 378. f. 1. 1932; Santapau in J. Bombay Nat. Hist. Soc. 49. 219. 1950 excl. syn. *U. purpurascens* Graham; Sundararaghavan et al. in Indian Forester 96: 503. 1970; Gandhi in Saldanha & Nicolson, Fl. Hassan 564. 1976; Rao & Razi, Syn. Fl. Mysore 531. 1981; Yoganarasimhan et al. Fl. Chikmagalur 241. 1981; Manilal & Sivarajan, Fl. Calicut 208. 1982; Sharma et al. Fl. Karnataka 195. 1984; Mukerjee, Fl. Pachmarhi Bori Res. 217. 1984; Rao, Fl. Goa 2: 308. 1986;

Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 130.

1987, excl. syn. - HOLOTYPE: INDIA. Koenig s.n. (C).

Utricularia pedicellata Wight in Hooker's J. Bot. Kew Gard.

Misc. 1: 373. 1849 & Ic. t. 1578. f. 2. 1850 (excl. seeds).-

HOLOTYPE: INDIA. Courtallam, Wight s.n. (K, Photo !).

Utricularia uliginoides Wight in Hooker's J. Bot. Kew Gard.

Misc. 1: 372. 1849 & Ic. t. 1573. 1850. - HOLOTYPE: INDIA.

Courtallam, 4.2.1836, Wight 2415 (K, Photo !).

Utricularia conferta Wight in Hooker's J. Bot. Kew Gard.

Misc. 1: 372. 1849 & Ic. t. 1575. 1850. - HOLOTYPE: INDIA.

Courtallam, August 1835, Wight 2417 (K, Photo !).

Utricularia equiseticaulis Blatter & McCann in J. Indian

Bot. Soc. 10: 122. 1931; Santapau in J. Bombay Nat. Hist.

Soc. 49: 221. 1950. - HOLOTYPE: INDIA. W. Ghats, Panchgani,

Dalkeith Springs, 3.10.1930, McCann and Fernandez 3508

(BLAT !).

Utricularia caerulea var. graminifolia (Vahl) Bhattacharyya

in Bull. Bot. Soc. Bengal 30: 76. 1976 (1978); Srivastava

in J. Econ. Tax. Bot. 4: 189. 1983.

Utricularia caerulea auct. non L.; Oliver in J. Proc. Linn.

Soc., Bot. 3: 179. 1859; Clarke in Hook.f. Fl. Brit. India

4: 331. 1884 p.p.; Cooke, Fl. Bombay 2: 318. 1905 (2: 392.

1958 repr. ed.) p.p.; Fyson, Fl. Nilgiri Pulney Hill tops

1: 307. 1915 & 2: t. 203. 1915.

Herbs, rhizoids up to 2.5 cm long, c 0.3 mm thick, numerous, glandular, tapering towards apex, branches up to 2.5 mm long, papillose; stolons up to 10 cm long, c 0.5

mm thick, profusely branched, glandular. Foliar organs up to 10 x 1.5 cm, linear to strap-shaped, at base of scape and on stolons, 3-nerved, nerves branched further, rounded to obtuse or rarely retuse at apex. Traps 1-3 mm across, subglobose, slightly compressed, subdimorphic, numerous on vegetative organs; those on leaves sessile or subsessile, elsewhere long-stalked; mouth basal; appendages 2, subulate, simple, glandular. Racemes up to 30 cm long, 1-1.5 mm thick, erect, rarely branched, 1-9-flowered; scales 1-2 x 0.9-1.2 mm, basifixed, ovate to lanceate, rarely deltoid, 1- or 3-nerved, or nerves altogether absent, acute to acuminate at apex; bracts 1.5-2.5 x 1-1.5 mm, basifixed, ovate to lanceate, 1- or 3-nerved, acute to acuminate at apex; bracteoles 1-2.5 mm long, basifixed, subulate, 1-nerved; sterile bracts and bracteoles rarely seen among fertile ones; flowers 7-12 mm long; pedicels up to 11 mm long, erect, slightly winged. Calyx-lobes ovate to lanceate; upper lobes 3-6 x 2-3.5 mm, acuminate or rarely caudate at apex; lower 2.5-5.8 x 1.5-3 mm, 2-4-dentate at apex. Corolla blue to violet or pink; upper lip 4-6.5 x 2-3.5 mm, linear-oblong, longitudinally streaked, crested at centre, ciliate along lower margin, truncate, rounded or obtuse at apex; lower lip 4-7 x 3-7 mm, obovate, rarely orbicular, hairy in throat, bigibbous at base, obscurely 3-lobed, rounded or retuse at apex; spur 4.5-7 mm long, curved, conical, acute at apex. Stamens 1.5-2 mm long; filaments strap-shaped; anther thecae distinct. Pistil

1.5-2 mm long; ovary ovoid, compressed; style short; stigma 2-lipped, upper lip semiorbicular, lower truncate and hairy. Capsules 3-4 mm long, ovoid, thickened along dehiscent margin; placenta 1.6-2.5 x 1-1.5 mm, oblongoid or ovoid, compressed. Seeds 0.2-0.4 mm across, subglobose to obovoid; hilum terminal, prominent; testa cells reticulate. (Fig. 15).

Fl. & Fr.: Throughout the year.

Ecology: In marshy places, near perennial water sources and water-falls in hilly areas; among grasses and on soil covered rocks, from 400 m upwards.

Distribution: Southern India and Sri Lanka; in India distributed in Maharashtra, Karnataka, Kerala and Tamil Nadu, along W. Ghats, Madhya Pradesh in Central India and Andhra Pradesh in E. Ghats. (Map 5).

Pollen: Isopolar, tetracolporate or pentacolporate, 4-5-lobed in polar view, elliptic in equatorial view. Longiaxe pollens 30-33 x 25-28 μ ; breviaxe pollens 27-28 x 31-32 μ . (Thanikaimoni 1966).

Notes: A highly variable species; several separate taxa have been recognised in the past. There may not be any difficulty in separating extreme forms but with a large series of specimens one finds an almost imperceptible gradation. It is considered necessary to reduce U. equiseticaulis Blatter & McCann, an extreme form wherein the fruiting calyx-lobes and seeds appear quite distinct, to U. graminifolia Vahl, as done by Sundararaghavan et al. (1970).

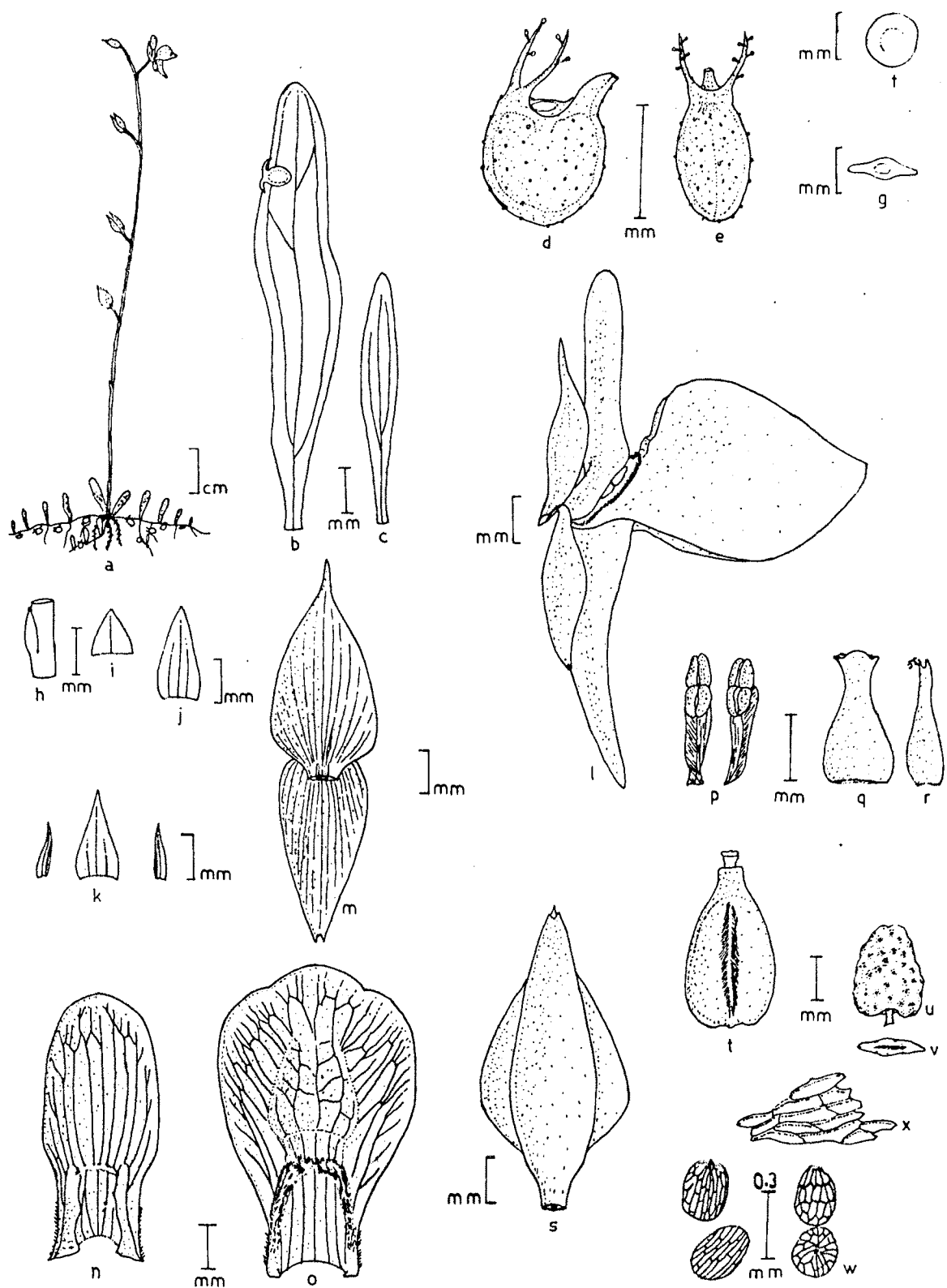


Fig. 15. *Utricularia graminifolia* Vahl: a. Plant; b, c. Foliar organs; d. Trap - lateral view; e. Trap - front view; f. T.S. of scape; g. T.S. of pedicel; h. Scale on scape; i, j. Scales; k. Bract & bracteoles; l. Flower; m. Calyx; n. Corolla - upper lip; o. Corolla - lower lip; p. Stamens; q. Pistil - adaxial view; r. Pistil - lateral view; s. Fruit; t. Capsule; u. Placenta; v. T.S. of placenta; w. Seeds; x. Testa cells.

Specimens examined:

ANDHRA PRADESH: Visakhapatnam dist., Anjoda-Gengigedda, 925 m, 12.3.1965, G.V. Subba Rao 22611, 22612 (MH).

GOA: Castle rock, 1700 ft., Mar. 1919, Nana 5532 (CAL), 20.12.1953, H. Santapau 17772 (BLAT), 28.12.1968, M.R. Almeida 976 (BLAT); Dudhsagar, 19.9.1970, M.Y. Ansari 124034 (BSI).

KARNATAKA: N. Kanara, 20.1.1888, W.A. Talbot 1581 (BSI), 1582 (DD), Supa, 5.1.1889, W.A. Talbot 6966 (BSI); Belgaum dist., Poondur, 22.2.1898, W.A. Talbot 4017 (BSI); Bilgirikangan, 5000 ft., 13.2.1907, C.E.C. Fischer 1421 (CAL); S. Kanara, near Shiradi, Nov. 1908, A. Meebold 10329 (CAL); N. Kanara, Anmod, 25.12.1917, L.J. Sedgwick 3270 (CAL, PCM), Anmod jungle, 7.2.1950, J. Fernandez JF 936 (BLAT), Supa, 2.4.1950, J. Fernandez JF 1177 (BLAT); Dharwar dist., Daudeli, 24.4.1950, H. Santapau 10908 (BLAT); Mysore dist., Kachugaranapodu, 1125 m, 27.4.1962, A.S. Rao 80402 (CAL); Shimoga dist., Kavaledurga, 2.10.1962, R. Sundararaghavan 82904 (BSI); Mysore, Hulical-Yedur, 12.2.1963, R. Sundararaghavan 86068 (BSI); S. Kanara, near Shiradi, 17.10.1978, Cecil J. Saldanha & K.R. Keshavamurthy KFP 3385 (CAL).

KERALA: Wynad, Tambracheri Ghat, 21.1.1903, C.A. Barber 5707 (MH); S. Malabar, Muttikulam, 3000 ft., 31.10.1910, C.E.C. Fischer 2375 (CAL); Palghat dist., Karapara river bed, 900 m, 29.10.1976, E. Vajravelu 48751 (CAL,

MH), Kunthipuzha river, 900 m, 23.4.1980, V.J. Nair 67268 (CAL, MH), Madimarathode, 825 m, 30.4.1980, V.J. Nair 67407 (CAL, MH), Aruvampara slopes, 850 m, 8.12.1980, N.C. Nair 69170 (MH), Valiyaparathode grany slopes, 1000 m, 12.12.1980, N.C. Nair 69564 (MH), Karapara forest - Nelliampathy R.F., 1000 m, 19.12.1980, N.C. Nair 69649 (MH).

MADHYA PRADESH: Pachmarhi, 18.2.1891, J.F. Duthie 10492 (CAL, DD); Mandla dist., 1901, J. Marten s.n. (DD); Bastar, Bailadila hill, 1940, H.F. Mooney 1462 (DD), Thirathgarh falls, 600 m, 9.2.1961, N.P. Balakrishnan & A.N. Henry 12033 (CAL, MH), Bailadila, Kutumsar, 19.2.1963, G. Panigrahi 1125 (CAL).

MAHARASHTRA: Bombay, Dalzell s.n. (CAL); Mahableshwar, Oct. 1891, Cooke s.n. (BSI); Panchgani, 16.11.1902, R.K. Bhide 1105 (BSI); Mahableshwar, 17.3.1908, H.M. Chibber s.n. (BSD), Chinaman's falls, 27.12.1950, P.V. Bole PVB 111 (LWG), Dhobi falls, 4,500 ft., 15.10.1957, S.D. Mahajan 24743 (BSI), Ludwig point, 12.10.1960, M.Y. Ansari 67637 (BSI), Lingmalla falls, 2.3.1967, B.M. Wadhwa 109669 (BSI), Lingmalla falls, 8.10.1985, M.K. Janarthanam 82948, 82949 (MH).

TAMIL NADU: Courtallam, April 1835, Wight 2417 (CAL); Coonoor, Nilgiris, 7000 ft., 16.3.1870, C.B. Clarke 10947 (CAL), 11.2.1894, Dr. Prain s.n. (CAL, Acc. no. 330118); Kodaikanal, Mar. 1898, Bourne 17 (PCM); Anamalai hills, Parampara swamp, 7500 ft., 2.4.1912, C.E.C. Fischer 3318 (CAL), Attakatti, 27.12.1912, C.E.C. Fischer 3222 (CAL);

Courtallam, 29.11.1913, M. Rama Rao's coll. 1976 (CAL), 21.9.1943, 500 ft., Daniel Sunderaraj 20403 (MH); Nilgiri dist., Kottaicombai, 1933 m, 23.10.1956, K. Subramanyam 1099 (CAL, MH), Kateri Road to Kundha, 1667 m, 27.3.1957, K.M. Sebastine 2705 (CAL, MH); Tirunelveli dist., Shembaka Devi falls, Courtallam, 533 m, 23.4.1957, K. Subramanyam 2885 (CAL, MH), Main falls - Courtallam, 433 m, 16.12.1957, K. Subramanyam 4944 (CAL, MH); Coimbatore dist., Siruvani, Muthukulam, 24.4.1961, A.N. Henry ANH 1358 (BLAT), Attakatti, 900 m, 25.1.1962, J. Joseph 13552 (MH), 13565 (CAL), Monica estate, 950 m, 23.1.1963, J. Joseph 15558 (CAL, MH), Varattupparai-Monica estate, 575 m, 18.4.1963, J. Joseph 16218 (MH); Tirunelveli dist., Oothu, 1000 m, 29.5.1963, A.N. Henry 16363 (CAL, MH); Coimbatore dist., Sholaiyar submergible area, 1030 m, 25.12.1963, K. Ramamurthy 18102 (MH); Tirunelveli dist., Sengaltheri, 900 m, 19.9.1967, E. Vajravelu 29126 (MH); Madurai dist., Tiger Shola, 1900 m, 17.9.1968, D.B. Deb 30937 (MH); Nilgiri dist., Kotagiri Ooty road, 1900 m, 8.3.1969, D.B. Deb 31507 (MH); Coimbatore dist., Vellingiri 7th hill top, 1700 m, 27.4.1969, S. Karthikeyan & M. Chandrabose 31816 (CAL, MH); Kanniyakumari dist., Neerpadu falls, Kunnimuthu estate, Panagudi, 630 m, 2.12.1969, B.V. Shetty 33005 (CAL, MH); Nilgiri dist., Shola near Kodanad estate, 1950 m, 21.7.1970, E. Vajravelu 35006 (MH), Marappalam-Burliar Road, 1200 m, 7.9.1970, B.D. Sharma 36083 (MH), Ebanad to Anaikatty, 1700 m, 8.9.1970, G.V. Subba Rao 36573 (MH), Shola near Kukalthorai,

1500 m, 13.9.1970, G.V. Subba Rao 36663 (MH); Kanniyakumari dist., Neerpadu falls, Panagudi, 630 m, 6.2.1972, B.D. Sharma 39974 (MH); Nilgiri dist., Coonoor-Marappalam, 1400 m, 1.3.1972, B.D. Sharma 40354 (MH), Shola on way to Iduhatti from Bikkapathimund, 1925 m, 26.3.1972, G.V. Subba Rao 40483 (MH); Kanniyakumari dist., Kilaviarumalai-Balamore, 500 m, 29.8.1976, A.N. Henry 48133 (CAL, MH); Tirunelveli dist., Kalakad, Thalaiyodai, 800 m, 8.4.1983, N. Parthasarathy 434 (MH); Coimbatore dist., Stanmore estate, Valparai, 23.2.1985, M.K. Janarthanam 82903 (MH), Monica estate, 24.2.1985, M.K. Janarthanam 82906 (MH), Kadamparai, 25.2.1985, M.K. Janarthanam 82907 (MH), Attakatti, 26.2.1985, M.K. Janarthanam 82908 (MH), Rottikadai, 26.2.1985, M.K. Janarthanam 82909 (MH), Cinchona, 27.2.1985, M.K. Janarthanam 82910, 82911 (MH).

13. *Utricularia hirta* Klein ex Link, Jahrb. 1(3): 55. 1820; Oliver in J. Proc. Linn. Soc., Bot. 3: 183. 1859; Drury, Handb. Ind. Fl. 2: 124. 1866; Clarke in Hook.f. Fl. Brit. India 4: 332. 1884; Prain, Bengal Pl. 2: 582. 1903 (2: 582. 1963 repr. ed.); Haines, Bot. Bihar Orissa 3 & 4: 676. 1922 (2: 676. 1961 repr. ed.); Mooney, Suppl. Bot. Bihar Orissa 102. 1950; Joseph & Ramamurthy in J. Bombay Nat. Hist. Soc. 58: 701. 1961; Abraham & Subramanyam in Proc. Indian Acad. Sci. 62B: 98. 1965; Basak in Bull. Bot. Surv. India 17: 102. 1975 (1978); Taylor in Steenis, Fl. Males. I. 8: 287. 1977; Rani & Matthew in Matthew,

Fl. Tamilnadu Carnatic 3: 1116. 1983; Srivastava in J. Econ. Tax. Bot. 4: 190. 1983; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 130. 1987. - HOLOTYPE: S. INDIA. Klein (B, microfische !).

Utricularia capillacea Vahl, Enum. Pl. 1: 204. 1804, non Willd. 1797. - TYPE: India orientali, Rottler.

Utricularia setacea Wall. ex Oliver in J. Proc. Linn. Soc., Bot. 3: 183. 1859 pro syn.

Utricularia tayloriana Joseph & Mani in Bull. Bot. Surv. India 24:103. 1982; Joseph & Joseph, Insect. Pl. Meghalaya 21. 1986. - HOLOTYPE: INDIA. Meghalaya, Khasia & Jaintia hills, 20th Km on Shillong Pynursla road, 26.8.1980, Joseph 73568 (ASSAM ! to be deposited at CAL).

Herbs; rhizoids up to 6 mm long; stolons up to 1 cm long, glandular, sparsely branched. Foliar organs up to 15 mm, linear, 1-nerved, glandular, obtuse at apex. Traps c 0.3 mm across, subglobose; stalk short; mouth lateral; appendages of three connate processes, the one on upper lip subulate, two laterals wing-like with gland tipped processes. Racemes up to 12 cm long, erect, filiform, terete, simple or branched, densely hairy throughout, 1-4-flowered; scales similar to bracts; bracts c 0.8 mm long, basifixed, linear-lanceate, 1-nerved, hairy, acute at apex; bracteoles more or less equal to bracts in length, linear, 1-nerved, hairy; flowers up to 7 mm long; pedicels 1-2 mm long, erect, terete. Calyx-lobes subequal, c 1.5 x 1 mm

(c 3 x 2 mm in fruit), ovate, hairy, obtuse to emarginate at apex, rarely lower lobe splits into two. Corolla pink to light violet; upper lip up to 3 mm long, oblong, constricted at middle, emarginate at apex; lower lip c 3 x 3 mm, obovate, slightly 3-lobed, raised at base; spur 3-5 mm long, subulate, horizontal or slightly curved upwards, constricted at middle, acute at apex. Stamens c 1 mm long; filaments linear, curved; anther thecae distinct. Pistil c 1 mm long; ovary ovoid; style short, thick; stigma 2-lipped, lower lip semiorbicular, upper shallowly 3-lobed. Capsules up to 1.8 mm across, obliquely subglobose, thickened along dehiscent margin; placenta c 1 mm across, subglobose. Seeds c 0.2 mm across, subglobose; hilum not prominent; testa cells few, large, slightly elongated. (Fig. 16).

Fl. & Fr.: August-January.

Ecology: Sprouts immediately after monsoon; in wet and marshy open sandy places from sea-level to 1800 m.

Distribution: India to Malesia; in India recorded from Uttar Pradesh, Bihar, W. Bengal, Meghalaya, Orissa and Tamil Nadu. (Map 6).

Pollen: 3-aperture, 33 x 29 μ (Huynh 1968).

Notes: Utricularia hirta Klein ex Link is allied to U. minutissima Vahl but can be easily differentiated by the presence of septate hairs and thickening along the dehiscent margin of the capsule. Though described on the basis of South Indian material, it was not included in Gamble l.c.

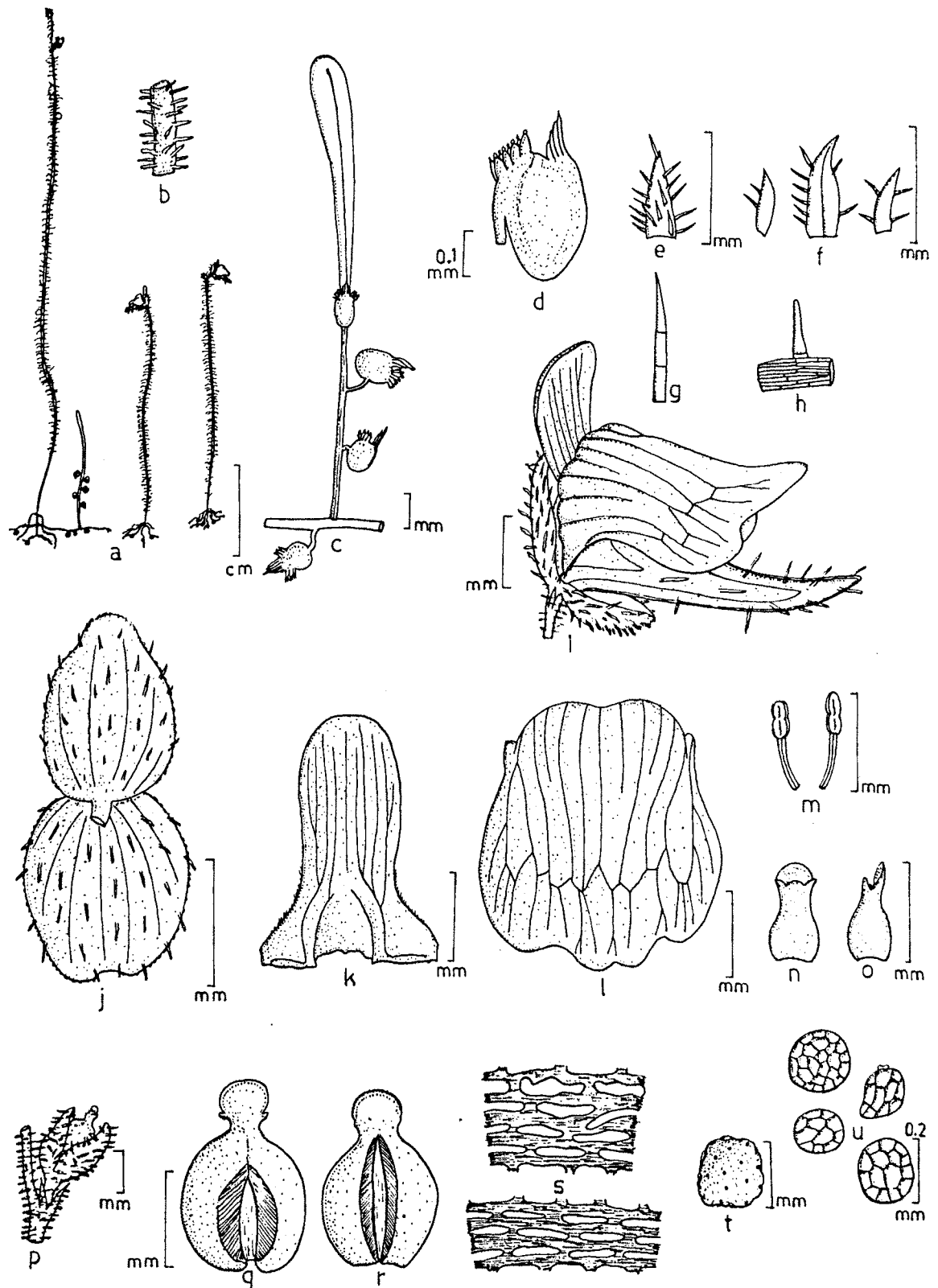
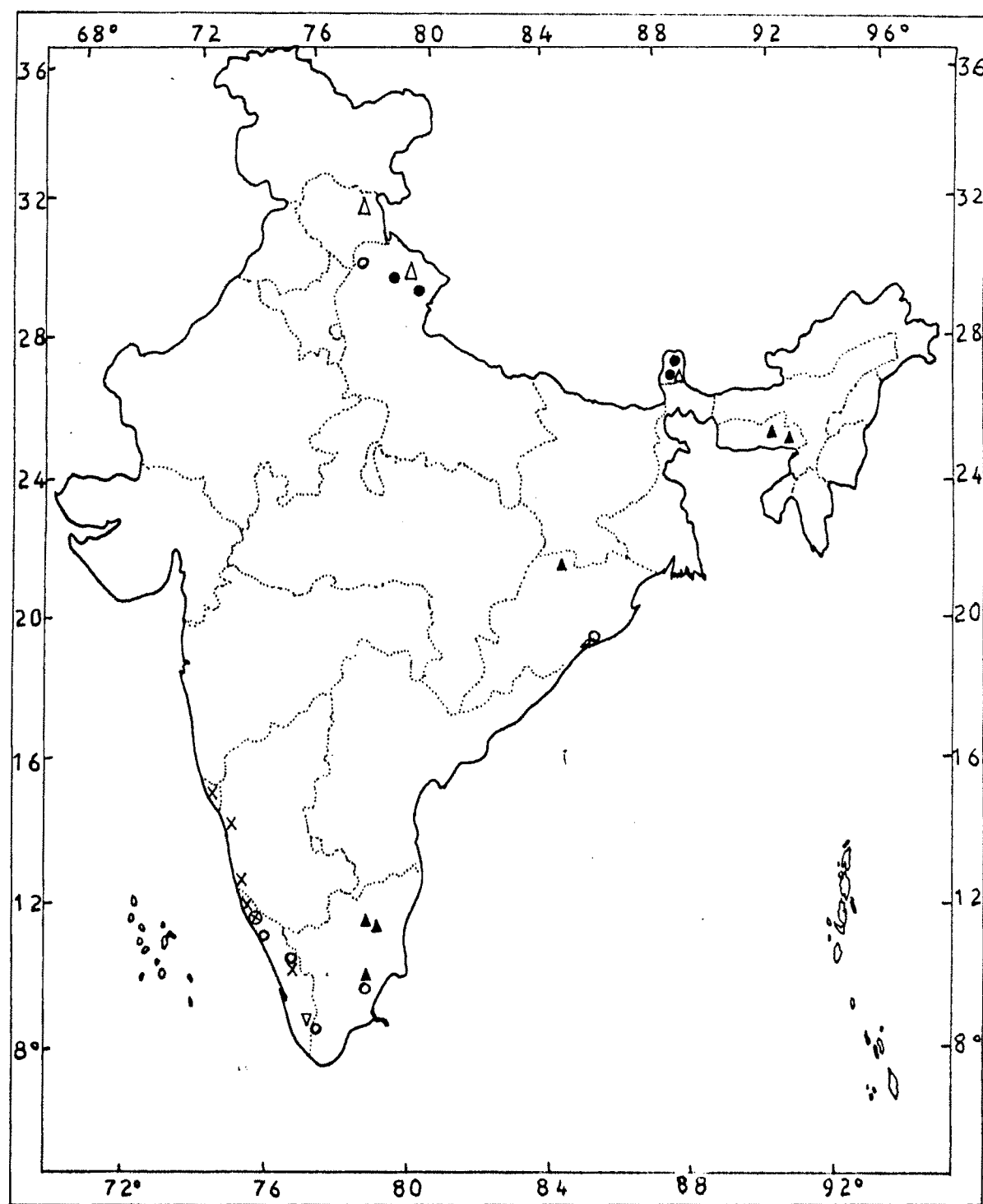


Fig. 16. *Utricularia hirta* Klein ex Link: a. Plants; b. A portion of scape; c. Foliar organ with traps; d. Trap; e. Scale; f. Bract & bracteoles; g. Hair on scape; h. Hair on stolon; i. Flower; j. Calyx; k. Corolla - upper lip; l. Corolla - lower lip; m. Stamens; n. Pistil - adaxial view; o. Pistil - lateral view; p. Fruit; q, r. Capsules; s. Ornamentation in capsule wall; t. Placenta; u. Seeds.



Map 6. Distribution: ▲ *Utricularia hirta* Klein ex Link
 ▽ *U. keralensis* M.K. Janarthanam
 ● *U. kumaonensis* Oliver
 × *U. lazulina* Taylor
 ⊗ *U. malabarica* M.K. Janarthanam & A.N. Henry
 Δ *U. minor* L.
 ○ *U. minutissima* Vahl

Utricularia tayloriana Joseph & Mani described from Meghalaya is treated conspecific with U. hirta Klein ex Link in this work after critical study of type materials and scrutinization of protologue. U. hirta reported earlier by Clarke (l.c.) from Khasia hills was overlooked by Joseph & Joseph (l.c.).

Specimens examined:

MEGHALAYA: Khasia, Pooriang, 14.10.1867, C.B. Clarke 5796 (CAL), Mausmai, 4.10.1871, C.B. Clarke 16259 (CAL), 2-4,000 ft., J.D. Hooker & T. Thomson s.n. (CAL, Acc. no. 330166), 1.9.1886, C.B. Clarke 44833 (CAL), Jowai, 1500 m, 31.8.1980, H. Deka 77232 (ASSAM).

ORISSA: Talcher state, Paipal dalki, 300 ft., 15.2.1940, H.F. Mooney 1645 (DD).

TAMIL NADU: South Arcot dist., Gingee R.F., 12.2.1960, K. Ramamurthy 14865 (MH); Tiruchirappalli dist., Narthamalai Forest, 23.9.1965, K. Ramamurthy 25942 (MH); North Arcot dist., Veerambakkam, 16.1.1986, M.K. Janarthanam 82977 (MH).

W. BENGAL (?): Manbhum, J. Campbell s.n. (DD).

14. *Utricularia keralensis* M.K. Janarthanam sp. nov.
Utricularia keralensis M.K. Janarthanam sp. nov. U. bifida L. affinis sed pedicellis in fructiferum erectis; calicibus lobis ad apicem acutis, acuminatis vel dentatis; labio infero corollam ligulis fimbriatis et testa cellulis intra non striatis differt.

HOLOTYPE: INDIA. Kerala, Quilon Dist., Pathanamthitta, c 325 m, 30.7.1978, C.N. Mohanan 58342 (CAL). (Photo 10).

Herbs; rhizoids up to 8 mm long, thick at base, tapering towards apex, glandular; stolons filiform. Racemes up to 15 cm long, erect, glabrous, 2-5-flowered; scales c 1.2 x 0.8 mm, basifixed, ovate, 3-nerved, acute to acuminate at apex; bracts c 1.5 x 1.2 mm, basifixed, ovate, 3-nerved, acute to acuminate at apex; bracteoles c 1 mm long, subulate to linear; flowers up to 7 mm long; pedicels up to 2.5 mm long, shorter than calyx-lobes, erect, winged. Calyx-lobes subequal, ovate, denticulate; upper lobe c 3 x 2.8 mm (c 4 x 4 mm in fruit), acute to acuminate at apex; lower lobe c 2.4 x 2 mm (c 4 x 3 mm in fruit), 2-4-dentate at apex. Corolla yellow; upper lip 3 mm long, cucullate, crested at middle on ventral side, hairy along lower margin, obtuse at apex; lower lip c 3 x 2 mm, more or less obovate, hairy along the margin of throat, gibbous at base, rounded at apex, ligulate; ligule fimbriate along margin; spur conical, acute. Stamens c 1 mm long; filaments linear; anther thecae distinct. Pistil c 1 mm long; ovary ovoid; style thick; stigma 2-lipped. Capsules c 2.5 x 1.8 mm, ovoid, uniformly membranous; placenta c 1.5 x 1.4 mm, ovoid, compressed. Seeds c 0.3 mm long, oblongoid; hilum terminal; testa reticulate, scrobiculate. (Fig. 17).

Fl. & Fr.: July-August.

Ecology: Along marshy places.

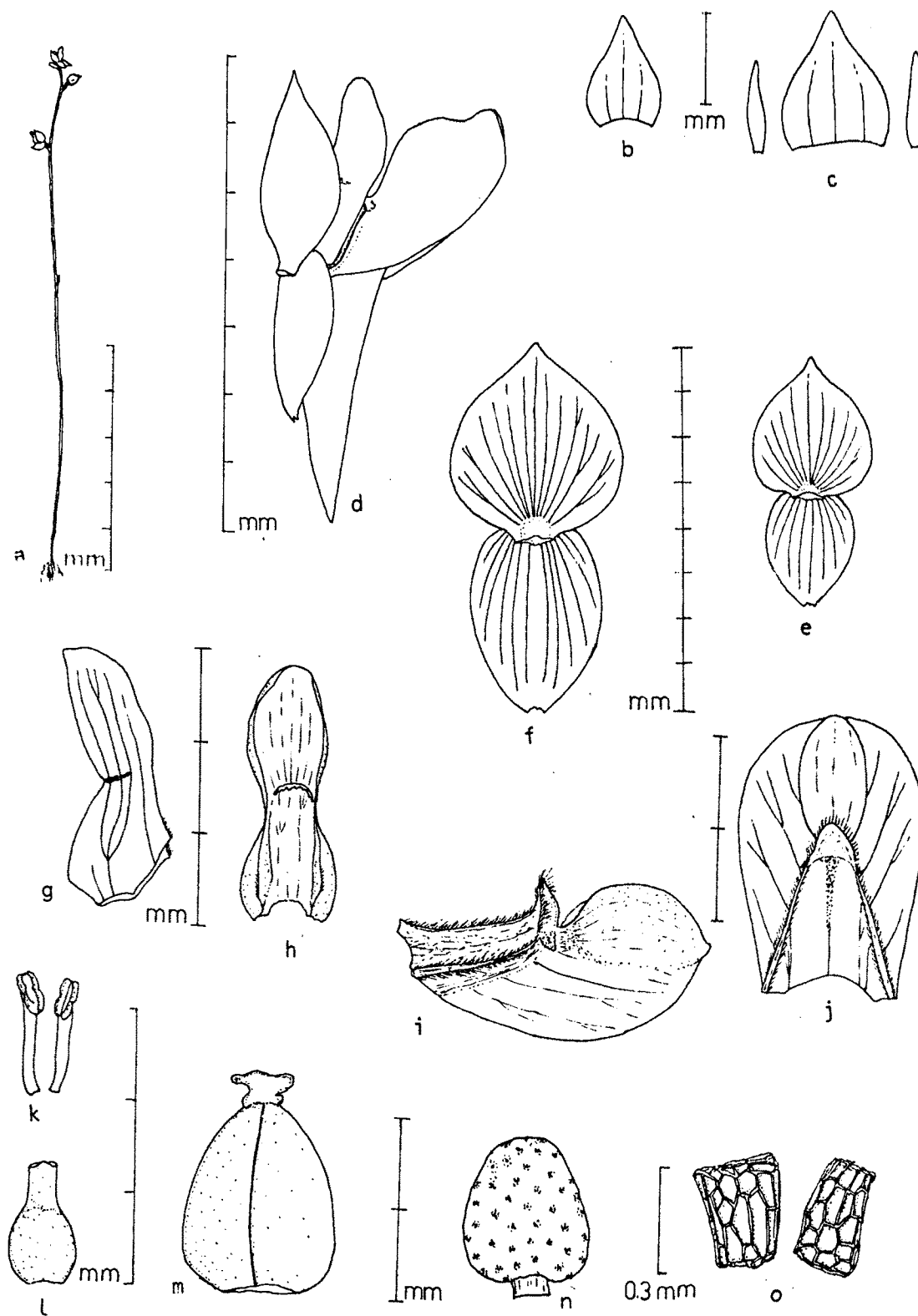


Fig. 17. *Utricularia keralensis* M.K. Janarthanam sp. nov.: a. Plant; b. Scale; c. Bract & bracteoles; d. Flower; e. Flowering calyx; f. Fruiting calyx; g. Corolla - upper lip (lateral view); h. Corolla - upper lip (front view); i. Corolla - lower lip (lateral view); j. Corolla - lower lip (front view); k. Stamens; l. Pistil; m. Capsule; n. Placenta; o. Seeds.

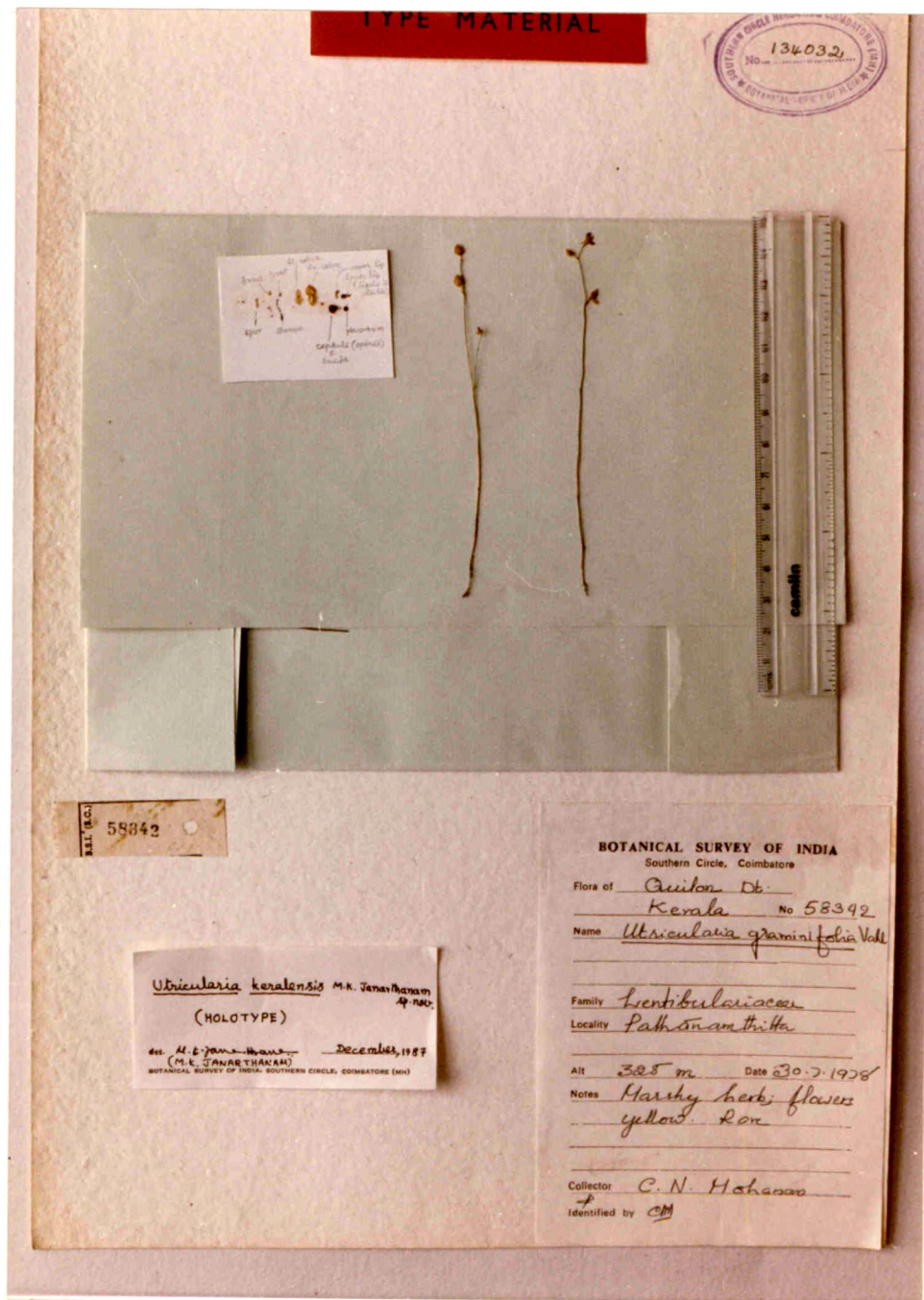


Photo 10. *Utricularia keralensis* M.K. Janarthanam sp. nov.
(Holotype - CAL).

Distribution: Known only from the type locality.
(Map 6).

Notes: From the field notes it is inferred that this terrestrial bladderwort occurs rare in the type locality. The presence of ligule on lower lip of corolla is unique and is useful in segregating this species from all other *Utricularias* in India. *Utricularia keralensis* can be easily differentiated from its allied *U. bifida* L. as follows:

	<u>U. bifida</u> L.	<u>U. keralensis</u> sp.nov.
1. Calyx-lobes	Obtuse at apex	Acute to acuminate or dentate at apex
2. Lower lip of corolla	Ligule absent	Ligule present
3. Fruiting pedicel	Strongly recurved	Erect
4. Seeds	More or less ovoid; testa cells striated within	More or less oblong-oid; testa cells not striated within

Specimens examined:

KERALA: Quilon dist., Pathanamthitta, c 325 m, 30.7.1978, C.N. Mohanan 58342 (TYPE).

15. *Utricularia kumaonensis* Oliver in J. Proc. Linn. Soc., Bot. 3: 189. 1859; Benth. & Hook. f. Gen. Pl. 2: 968. 1876; Clarke in Hook. f. Fl. Brit. India 3: 334. 1884. - TYPE: as in Diurospermum album Edgew. (Photo 11).

Diurospermum album Edgew. in Proc. Linn. Soc. London 1: 351. 1848, non Utricularia alba Hoffmannⁿsegg ex Link, Jahrb. 1(3): 54. 1820. - NEOTYPE: W. Himalayas, Pilti, 7500 ft., Strachey & Winterbottom s.n. (K, Photo !). (Photo 11). Utricularia multicaulis sensu Taylor in Hara, Enum. Fl. Pl. Nepal 3: 132. 1982, p.p. non Oliver 1859.

Herbs; rhizoids not distinguishable; stolons up to 1 cm long. Foliar organs up to 17 mm long, rosulate at scape base and scattered on stolons; pseudopetioles up to 15 mm long, terete; expanded portion up to 2 x 3 mm, suborbicular, nerves dichotomously divided. Traps up to 2 mm across, subglobose, glandular, on stolons; mouth lateral; appendages of 5-7-radiating hairs from expanded lip. Racemes up to 5 cm long, erect, simple or branched, glabrous, 1-4-flowered; bracts c 1 mm long, medifixed, more or less oblanceate, acute at base, bidentate at apex; bracteoles c 1.5 mm long, medifixed, more or less oblong, constricted near the point of attachment, acute at base, bi- or tridentate at apex; flowers c 5 mm long; pedicels up to 9 mm long, filiform, erect or spread. Calyx-lobes unequal, papillose; upper lobe c 2 x 2.8 mm, more or less suborbicular, emarginate at apex; lower c 1 x 0.5 mm, oblong, truncate or bifid at apex. Corolla white; upper lip shorter than calyx-lobe, deltoid; lower lip up to 4 x 5 mm, 5-6-lobed, lateral lobes divergent and smaller; spur shorter than lower lip of corolla, cylindrical, obtuse at apex. Capsules up to 3.5 x 2.5 mm, more or less twice

longer than upper calyx-lobe, oblongoid, dehisce vertically on ventral side; placenta up to 1.3 mm long, flask-shaped, beaked, connecting base and apex of capsule. Seeds c 0.5 mm long, few, oblongoid to ellipsoid, appendaged on both ends; hilum not prominent; testa echinate. (Fig. 18a-k).

Fl. & Fr.: August & September.

Ecology: On moss covered rocks or on tree trunks at 2,250 m and above, up to snow line.

Distribution: Endemic to Himalayas: India, Nepal, Bhutan, Northern Burma, Southern Tibet and Southwest China; in India distributed in Uttar Pradesh and Sikkim. (Map 6).

Pollen: Isopolar, tetracolporate, circular in polar view, elliptic in equatorial view; $32 \times 42-44 \mu$ (Thanikai-moni 1966).

Notes: Utricularia kumaonensis Oliver was treated conspecific with U. multicaulis Oliver by Tailor (l.c.). But the latter can be easily differentiated from the former, by its thick recurved fruiting pedicel, globose to sub-globose capsule, and seeds appendaged on one side. Hence, U. kumaonensis Oliver is treated as a separate species. Oliver proposed U. kumaonensis, as a new name for Diurospermum album Edgew., because of the existence of the name Utricularia alba Haffmannsegg ex Link (1820) referring to a different species; in other words, the epithet alba was preoccupied in the genus Utricularia.

As the type specimen of Diurospermum album Edgew. could not be traced, it is concluded that all the original material used by Edgeworth has presumably been lost or destroyed. The specimen subsequently used by Oliver (Strachey & Winterbottom s.n., collected in Pilti at 7500 ft., in W. Himalayas - K) best fits the protologue and hence selected as neotype. Taylor in Herb. Kew has erroneously labelled this material as "Type" of "U. kumaonensis Oliver".

As stated above, Oliver (1859) proposed U. kumaonensis only as a new name for the earlier Diurospermum album Edgew. (1848). But Taylor erroneously treated U. kumaonensis Oliver (1859) as a new species of Oliver attributing its priority dating only from 1859. This is evident in his treatment (Hara, Enum. Fl. Pl. Nepal 3: 132. 1982) of wrongly synonymising the earlier U. kumaonensis under the later name - U. multicaulis Oliver (1859). The correct name for the combined species should have been the priorable U. kumaonensis Oliver based on Diurospermum album Edgew. (1848).

Specimens examined:

SIKKIM: Lachung, 9,500 ft., 8.8.1892, G.A. Gammie 693 (CAL, DD); Kopup, 13,00 ft., 3.9.1945, Bor's collector 35 (DD); Kyanlasha, 9,000 ft., 31.7.1945, Bor's collector 676 (DD); East district, Karponang, 21.9.1980, P.K. Hajra 746 (BSI, Gangtok).

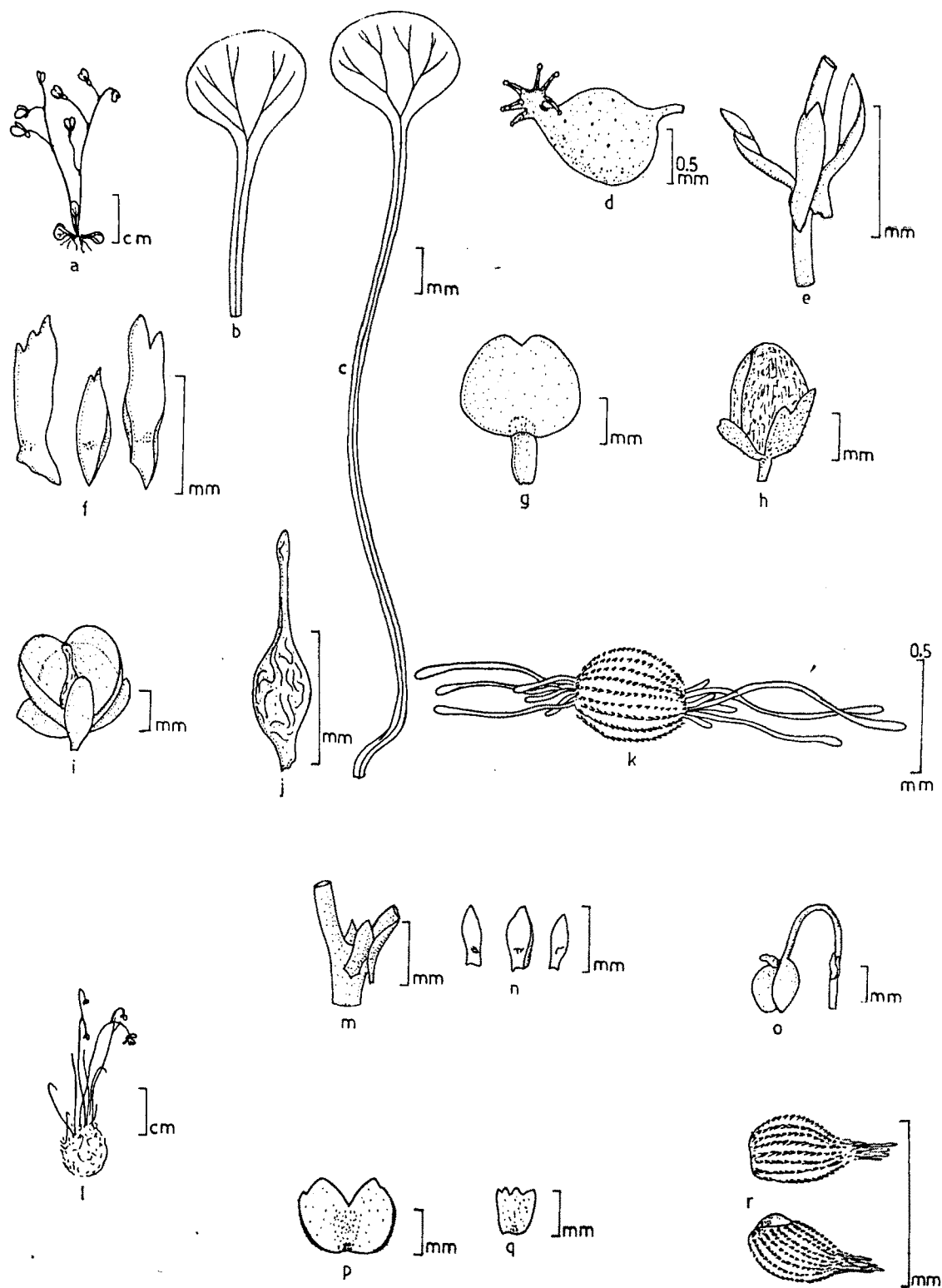


Fig. 18. *Utricularia kumaonensis* Oliver (a-k): a. Plant; b, c. Foliar organs; d. Trap; e. Bract & bracteoles on peduncle; f. Bract & bracteoles; g. Calyx; h. Fruit; i. Fruit - Capsule dehiscent open; j. Placentum; k. Seed. *Utricularia multicaulis* Oliver (l-r): l. Plant; m. Bract & bracteoles on peduncle; n. Bract & bracteoles; o. Fruit with recurved pedicel; p. Calyx - upper lobe; q. Calyx - lower lobe; r. Seeds.

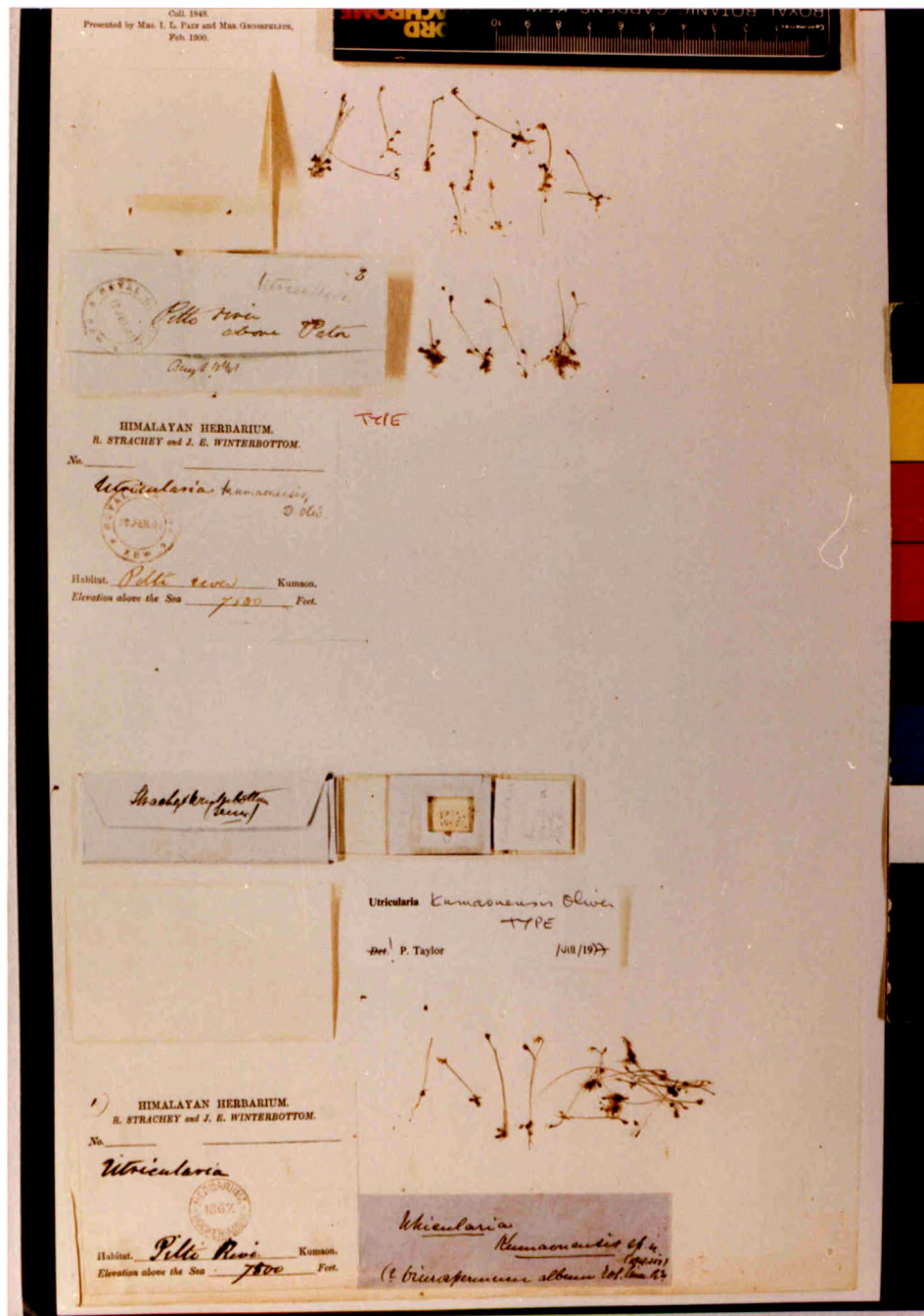


Photo 11. *Diurospermum album* Edgew. (\equiv *U. kumaonensis* Oliver) (Neotype selected - K).

UTTAR PRADESH: Brit. Garhwal, Uviari pass, 10.9.1885, J.F. Duthie 4266 (CAL), Saba Oodier environs (near Pilti bridge), 3,000 m, 21.9.1969, Pant & Naithani 39773 (BSD); Kumaon, Bakriudyar-Chipla, 3,700 m, 12.9.1971, C.M. Arora 45681 (BSD).

16. *Utricularia lazulina* Taylor in Proc. Indian Acad. Sci. (Plant Sci.) 93B: 101. 1984. - HOLOTYPE: INDIA. Karnataka, South Kanara, Kulshekar, Taylor 18021 (K, Photo !). (Photo 12).

Herbs; rhizoids up to 15 mm long, c 0.3 mm thick, tapering towards apex, branches 1-3 mm long, papillose; stolons up to 25 mm long, c 0.2 mm thick, sparsely branched. Foliar organs 2-10 mm long, obovate to oblanceate, distributed on stolons and at base of peduncle, 3-nerved, rounded at apex. Traps 0.7-2 mm across, subglobose, subdimorphic; stalk evenly or distally thickened; mouth basal; appendages 2, subulate, simple, recurved or divergent, glandular. Racemes 3.5-12 cm long, c 0.5 mm thick, erect; peduncle angular, grooved, winged, glabrous; scales 0.7-1.2 mm long, basifixed, ovate to lanceate, acute to acuminate at apex, nerves absent, rarely dormant buds are seen at axils; bracts 1-1.6 mm long, ovate to lanceate, acuminate, rarely acute or tridentate at ^{apex;} nerves absent or obscurely 1-nerved; bracteoles 0.75-1.2 mm long, subulate; flowers 7-11 mm long; pedicels 2-5 mm long (5-9 mm in fruit), erect in flower, spreading in fruit, narrowly winged.

Calyx-lobes slightly unequal; upper lobe 2-3 x 1.7-2 mm (3-3.75 x 2.5-3 mm in fruit), ovate, acute to acuminate at apex; lower lobe 2.4-3 x 1.2-1.8 mm (3.7-4 x 2-2.5 mm in fruit), lanceate to linear-ovate, bidentate or rarely acuminate at apex. Corolla clear blue to violet, rarely pink; ^{lower} lip 3-6 x 1.2-2 mm, oblong, constricted at middle, ciliate along lower margin, rounded at apex; lower lip 5-8 mm across, galeate, yellow and hairy at throat, bigibbous at base, truncate or rarely emarginate at apex; spur 5-7 mm long, subulate, curved, acute at apex. Stamens 1-1.5 mm long; filaments strap-shaped, slightly curved; anther thecae distinct. Pistil 1-1.5 mm long; ovary ovoid, compressed; style distinct, broad; stigma 2-lipped, semi-orbicular. Capsules 2-3 x 1.5-2.5 mm, ovoid, wall uniformly membranous; placenta 1-1.5 x 1-1.3 mm, ovoid, compressed. Seeds 0.2-0.35 mm long, obovoid; hilum prominent, subterminal; testa reticulate, cells elongated and verrucose within. (Fig. 19; Photo 5G).

Fl. & Fr.: July-September.

Ecology: Sprouts up immediately after rains in wet or water-logging places over laterite rocks, grasslands and rarely on soil-covered black boulders; from sea level to 700 m.

Distribution: Endemic to the hills and plains west of W. Ghats; Karnataka, North Kerala and Goa. (Map 6).

Pollen: 3-4-colporate, 25 x 30 μ , Taylor 18021 (K) (Taylor l.c.).

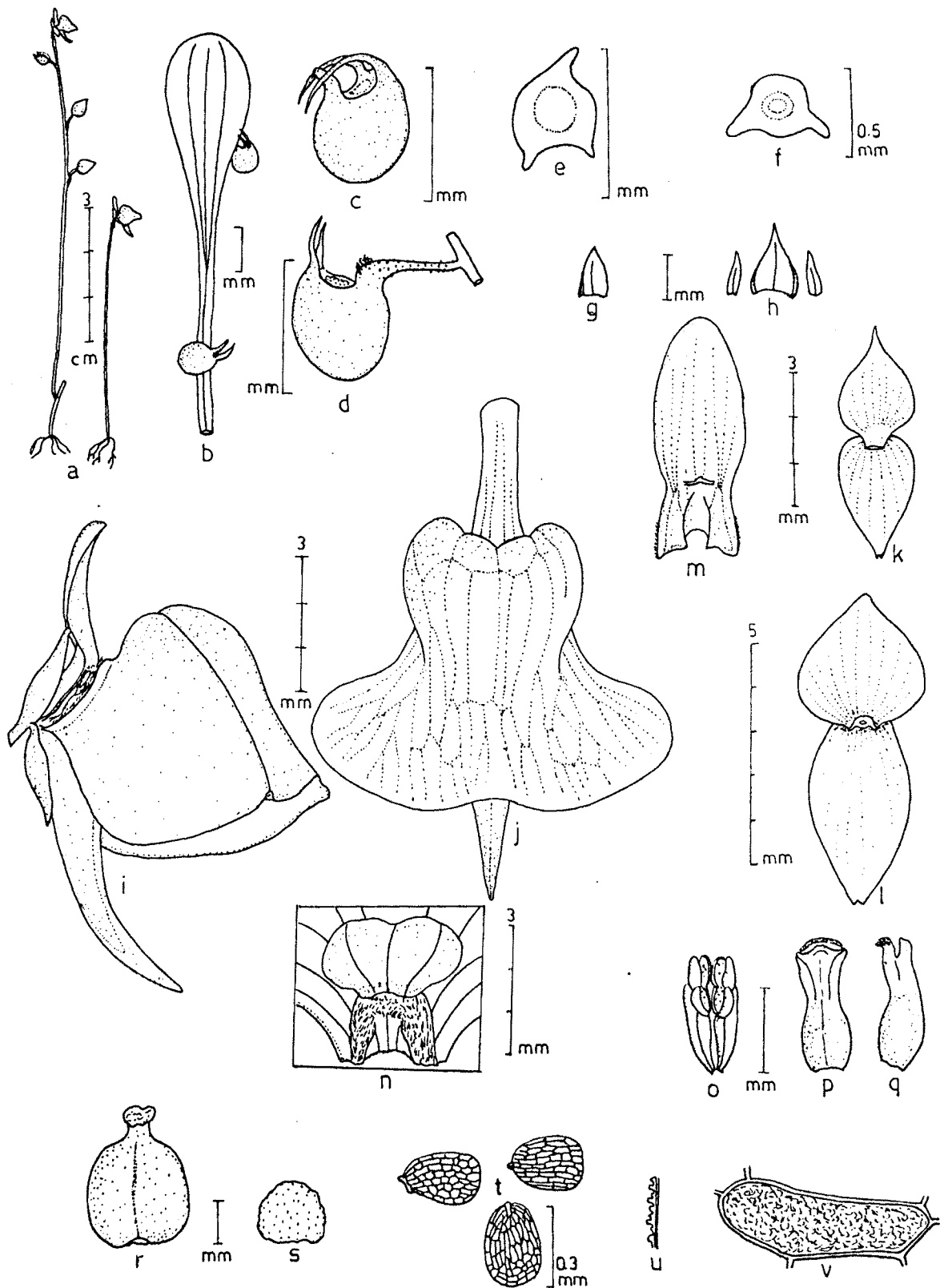


Fig. 19. *Utricularia lazulina* Taylor: a. Plants; b. Foliar organ; c. Trap - from foliar organ; d. Trap - from stolon; e. T.S. of scape; f. T.S. of pedicel; g. Scale; h. Bract & bracteoles; i. Flower - lateral view; j. Flower - front view; k. Flowering calyx; l. Fruit-calyx; m. Corolla - upper lip; n. Corolla - palate of lower lip; o. Stamens; p. Pistil - adaxial view; q. Pistil - lateral view; r. Capsule; s. Placentum; t. Seeds; u. T.S. of testa; v. Testa cell (showing verrucations).

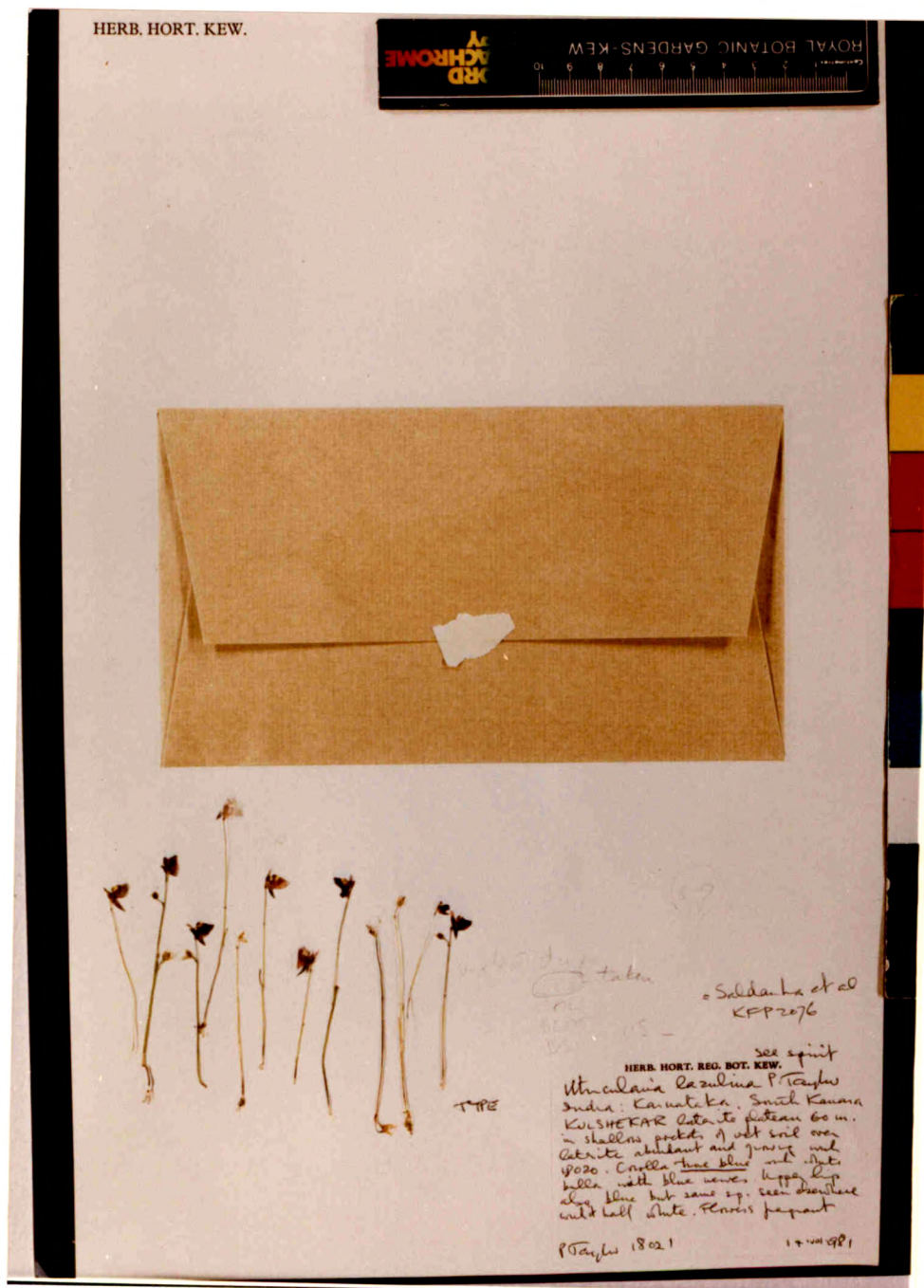


Photo 12. *Utricularia lazulina* Taylor (Holotype - K).

Notes: Utricularia lazulina Taylor is allied to U. albocaerulea Dalzell, but can be distinguished by its comparatively smaller flowers, oblong upper lip of corolla, absence of thickening along the dehiscing margin of capsule, and unique, verrucose testa cells.

This species earlier known only from its type locality is now recorded from Goa in north to Palghat district, Kerala in South.

Specimens examined:

GOA: Ordoford-Tudol, 24.8.1963, K.C. Kanodia 89507 (BSI).

KARNATAKA: N. Kanara, 2.10.1887, W.A. Talbot 1579 (CAL), Oct. 1919, Ambo 6880 (BLAT); South Kanara, Kulshekar, 19.8.1985, M.K. Janarthanam 82914 (MH).

KERALA: Kasaragod dist., Vidhyanagar, 18.8.1985, M.K. Janarthanam 82912 (MH), Kanjankad, Ramnagar, 20.8.1985, M.K. Janarthanam 82916, 82918 (MH), Mulleriya, 21.8.1985, M.K. Janarthanam 82922 (MH), Beemanadi, 22.8.1985, M.K. Janarthanam 82927 (MH); Palghat dist., Malampuzha, 15.9.1985, M.K. Janarthanam 82940 (MH).

17. Utricularia malabarica M.K. Janarthanam & A.N. Henry in J. Bombay Nat. Hist. Soc. ined. - HOLOTYPE: INDIA. Kerala, Kasaragod district, Mulleriya, 21.8.1985, M.K. Janarthanam 82924 (CAL !). (Photo 13).

Utricularia malabarica M.K. Janarthanam et A.N. Henry sp. nov. U. lazulina P. Taylor affinis, sed plantis parvis-
simis; calyce lobis equalibus et papillosis; corolla

margine labii superi glabra; labio infero stigmatis piloso; pedicello fructificanti recurvato; semine ovoideo et testa laevigata differt.

Holotypus (M.K. Janarthanam 82924, CAL) et isotypi (M.K. Janarthanam 82924, MH - num. acc. no. 139935-139938) in Mulleriya in ditone Kasaragod in statu Keralensi India die 21.8.1985 lecti.

Herbs; rhizoids usually absent, if present up to 1 cm long, c 0.2 mm thick at base, glandular, branches up to 0.8 mm long, papillose; stolons up to 2 cm long, c 0.2 mm thick, profusely branched. Foliar organs up to 4 x 1.5 mm, obovate to oblanceate, 3-nerved, rounded at apex. Traps up to 1.5 mm across, globose; stalk glandular; mouth basal; appendages 2, subulate, simple, glandular. Racemes 2-6.5 cm long, c 0.6 mm thick, erect, glabrous, angular, grooved on one side, 1-4-flowered; scales c 1.1 x 0.9 mm, basifixed, ovate-deltoid, acute to acuminate at apex; bracts c 1.5 x 0.9 mm, obovate to deltoid, acuminate at apex; bracteoles shorter than bracts, subulate; pedicels 3-4 mm long, winged, erect in anthesis, recurved in fruit. Calyx-lobes c 2 x 2 mm (c 3 x 3 mm in fruit), ovate, papillose without; upper lobe acuminate at apex; lower bidentate at apex. Corolla blue with white tinge; upper lip c 2.5 x 1.5 mm, oblong, truncate or emarginate at apex; lower c 4 x 5 mm, suborbicular, hairy in throat, bigibbous at base, emarginate at apex; spur c 4.5 mm long, slender, acute at apex. Stamens c 1 mm long; filaments

strap-shaped; anther thecae distinct. Pistil c 1 mm long; ovary ovoid; style short; stigma 2-lipped, lower lip oblong and hairy, upper lip short and semiorbicular. Capsules c 2.8 x 1.8 mm, ovoid to subglobose, uniformly membranous; placenta c 1 mm across, ovoid. Seeds c 0.25 mm long, ovoid; hilum prominent, subterminal; testa reticulate, smooth, cells more or less elongate. (Fig. 20; Photo 14).

Fl. & Fr.: August.

Ecology: A small, annual on wet laterite rocks, in association with Eriocaulons and grasses.

Distribution: Endemic to Kasaragod district of Kerala, India. (Map 6).

Notes: Known only from the type collection. The earlier collectors perhaps missed this species due to its habitat - the wet barren laterite rocks with very little vegetation, and its ephemeral nature as rocks dry immediately after the rains.

Utricularia malabarica M.K. Janarthanam & A.N. Henry is allied to U. lazulina Taylor, but can be differentiated by its shorter inflorescence, equal, papillose calyx-lobes, glabrous lower margin of upper corolla lip, hairy lower lip of stigma, recurved fruiting pedicel, and smooth testa cells.

Specimens examined:

KERALA: Kasaragod dist., Mulleriya, 21.8.1985, M.K. Janarthanam 82924 (CAL, MH - TYPES).

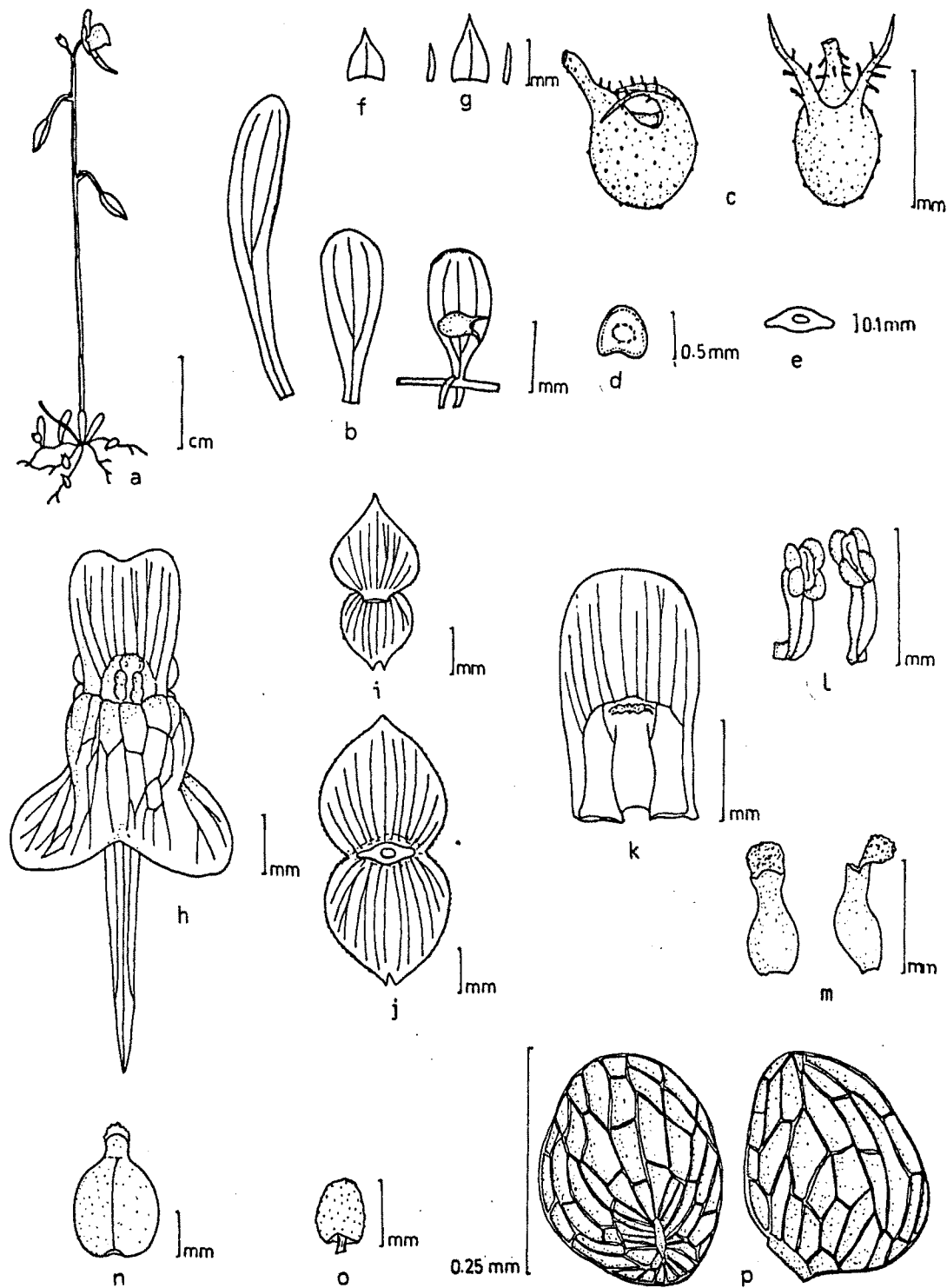


Fig. 20. *Utricularia malabarica* M.K. Janarthanam & A.N. Henry sp. nov. a. Plant; b. Foliar organs; c. Traps - different views; d. T.S. of scape; e. T.S. of pedicel; f. Scale; g. Bract & bracteoles; h. Flower; i. Calyx-lobes (flower); j. Calyx - lobes (fruit); k. Corolla - upper lip; l. Stamens; m. Pistil - different views; n. Capsule; o. Placenta; p. Seeds.

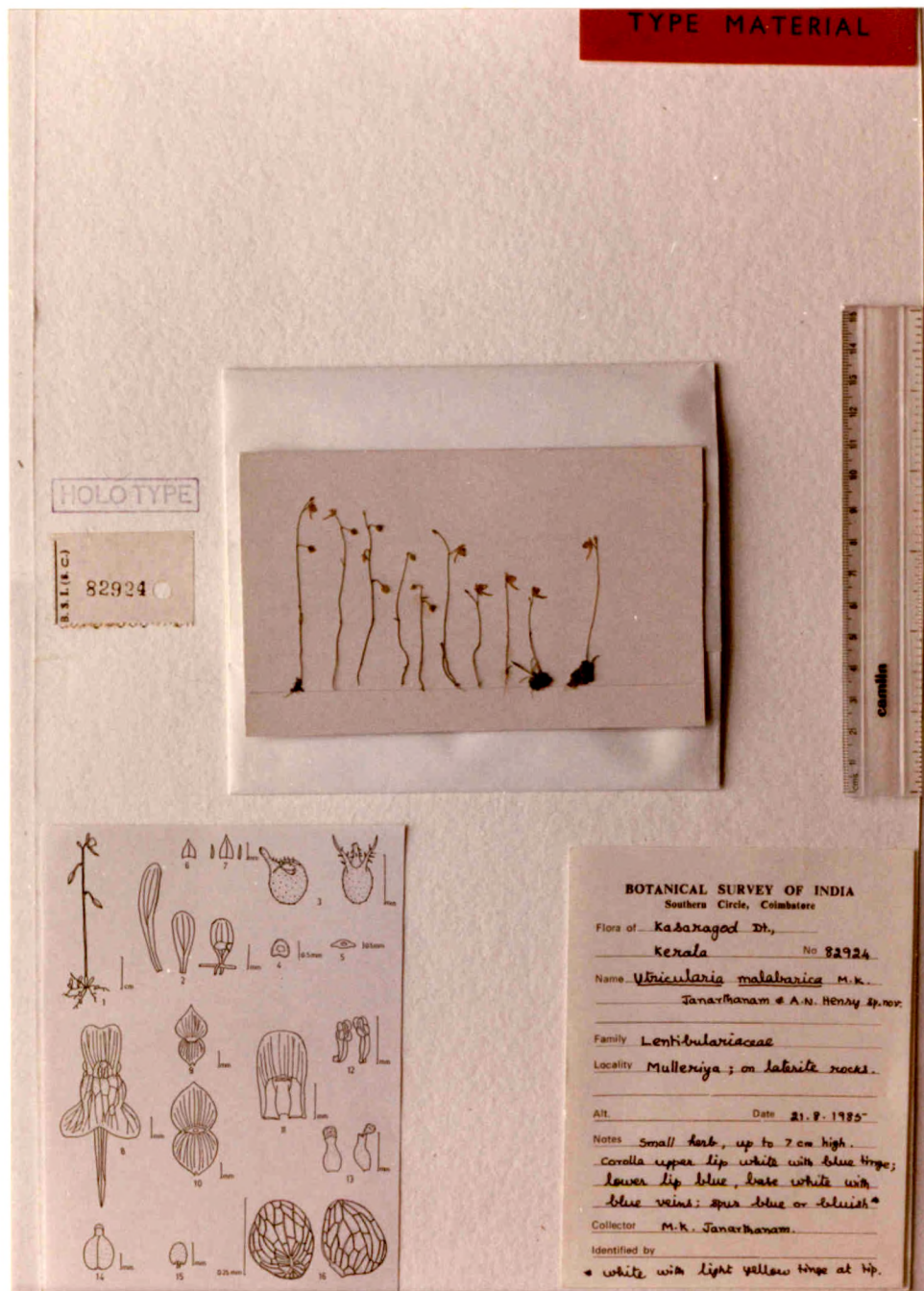


Photo 13. *Utricularia malabarica* M.K. Janarthanam & A.N. Henry sp. nov. (Holotype - K).



Photo 14. *Utricularia malabarica* M.K. Janarthanam &
A.N. Henry sp. nov.

18. *Utricularia minor* L. Sp. Pl. 18. 1753; Oliver in J. Proc. Linn. Soc., Bot. 3: 176. 1859; Clarke in Hook.f. Fl. Brit. India 4: 330. 1884; Taylor in Steenis, Fl. Males. I. 8: 299. f. 26. 1977 & in Hara et al. Enum. Fl. Pl. Nepal 3: 132. 1982; Kachroo et al. Fl. Ladakh 127. 1977; Wadhwa & Chowdhery in Chowdhery & Wadhwa, Fl. Him. Pradesh 2: 542. 1984. - HOLOTYPE: "Habitat in Europe fossis rarius" (LINN, microfische !).

Aquatic herbs; rhizoids absent; stolons up to 20 cm long, c 0.5 mm thick; turions c 0.2 mm across, globose, at apices of stolons and stolon branches. Foliar organs up to 1 cm long, palmately divided, polymorphic, c 0.1 mm wide in narrow segments, c 0.5 mm wide in broad segments, gland-dotted, often setulose at margins and apices. Traps up to 1.5 mm across, obliquely ovoid, on narrow leaf segments, absent in broad ones; mouth lateral, oblique; appendages 2, subulate. Racemes 5-15 cm long, erect, c 0.6 mm thick, glabrous, 2-3-flowered; scales 1.2-2 x 1-1.5 mm, basifixed, broadly ovate-deltoid, auriculate, obtuse at apex; bracts c 2.2 x 2 mm, broadly ovate-deltoid, auriculate, obtuse at apex; bracteoles absent; flowers c 0.8 mm long; pedicels 4-10 mm long, terete, erect at anthesis, apically recurved afterwards. Calyx-lobes ovate, subequal; upper lobe 1.8-2 mm across, suborbicular, obtuse or bidentate at apex; lower 1.5-2 mm across, suborbicular, dentate at apex. Corolla yellow; upper lip c 4 x 3 mm, ovate, obtuse to truncate at apex; lower lip c 6 x 5 mm, suborbi-

cular to ovate, raised at base, truncate at apex; spur c 1 mm long, saccate, glandular within. Stamens c 1 mm long; filaments strap-shaped, curved, dilated above; anther thecae confluent. Pistil c 1.2 mm long; ovary globose; style distinct; stigma 2-lipped, upper lip truncate or bidentate, lower lip ovate. Capsules c 3 mm across, globose, circumscissile. Seeds c 0.6 mm across, prismatic, narrowly winged. (Fig. 21).

Fl.: August.

Ecology: Submerged floating in stagnant water; 2,500-4,300 m.

Distribution: Circumboreal, extending southwards to the Himalayas, Burma and Malesia; in India distributed in Jammu & Kashmir and Uttar Pradesh. (Map 6).

Chromosomes: $2n = 36$ (Virendra Kumar & Subramaniam 1986).

Pollen: Isopolar, 14-15-colporate, synorate, 14-15-lobed in polar view, spindle shaped in equatorial view, $33-36 \times 28-30 \mu$ (Thanikaimoni 1966).

Notes: No fruiting specimens could be observed among Indian collections; hence the description of capsule and seeds is adopted from Taylor (l.c.).

Utricularia minor L. is allied to U. australis R. Br. among Indian Utricularias. The polymorphic foliar organs and saccate floral spur of the former are quite diagnostic.

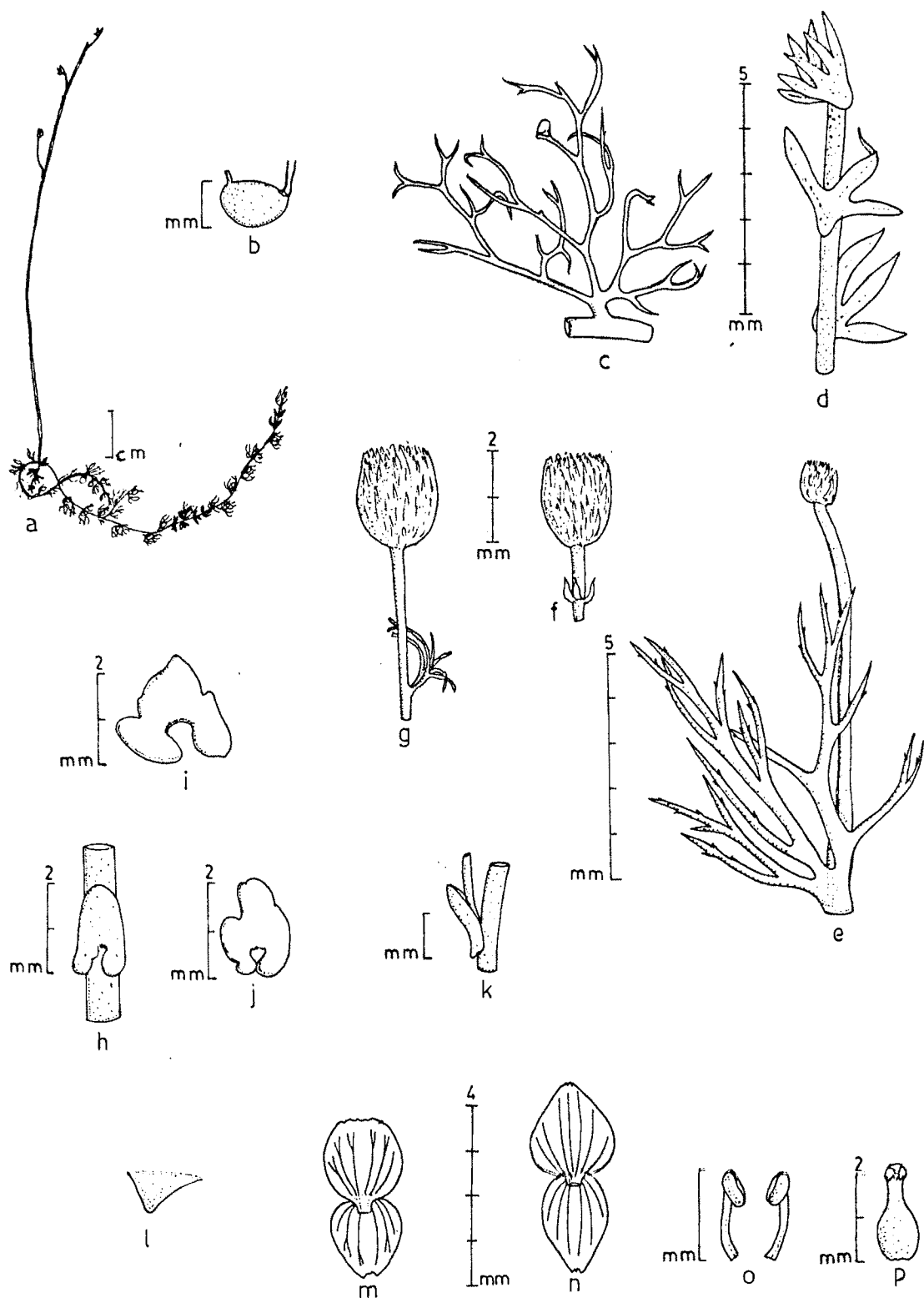


Fig. 21. *Utricularia minor* L.: a. Plant; b. Trap; c, d. Polymorphic foliar organs; e, f, g. Turions at apices of stolons; h. Scale on scape; i. Scale; j. Bract; k. Bract on peduncle; l. Spur; m, n. Calyx; o. Stamens; p. Pistil.

Specimens examined:

JAMMU & KASHMIR: Leh-Uphsi Road, 3,200 m, Ladakh, 4.8.1976, B.M. Wadhwa 59471 (BSD).

UTTAR PRADESH: Spiti, Gette, 4,300 m, 3.8.1972, U.C. Bhattacharya 49276 (BSD, CAL).

19. *Utricularia minutissima* Vahl, Enum. Pl. 1: 204. 1804; Oliver in J. Proc. Linn. Soc., Bot. 3: 190. 1859; Vasudevan Nair in J. Bombay Nat. Hist. Soc. 62: 180. 1965; Abraham in J. Bombay Nat. Hist. Soc. 63: 459. 1967; Ananda Rao & Banerjee in J. Bombay Nat. Hist. Soc. 64: 583. 1968; Basak in Bull. Bot. Surv. India 17: 102. 1975 (1978); Taylor in Steenis, Fl. Males. I. 8: 286. 1977; Subramanyam in Vignana Bharathi 3: 76. 1977. - HOLOTYPE: Malacca, Koenig s.n. (C).

Utricularia capillacea Wall. ex Oliver in J. Proc. Linn. Soc., Bot. 3: 184. 1859., non Willd. 1797. - TYPE: INDIA. Wight s.n. (K, CAL !).

Utricularia lilliput Pellegr. in Bull. Mus. Hist. Nat. (Paris) 26: 181. 1920; Subramanyam & Balakrishnan in Bull. Bot. Surv. India 2: 347. 1960; Babu, Herb. Fl. Dehra Dun 368. 1977.

Herbs; rhizoids up to 1 cm long, simple, glandular; stolons up to 2 cm long, glandular or glabrous, sparsely branched. Foliar organs up to 15 mm long, linear, 1-nerved, glandular and terete at base, rounded at apex. Traps 0.2-0.3 mm across, subglobose to ovoid, on vegetative

organs, stalked; mouth lateral, circular; upper lip with one subulate appendage ; lower lip with two, lateral, wing-like appendages of radiating rows of gland-tipped processes. Racemes 2-7 cm long, erect, reddish-brown, glabrous, 1-4-flowered; scales similar to bracts; bracts c 0.8 mm long, basifixed, linear-ovate, rarely 1-nerved, often united at base with bracteoles; bracteoles up to 0.8 mm long, at least half as wide as bracts, linear-ovate, 1-nerved; flowers c 4 mm long; pedicels up to 0.5 mm long, terete. Calyx-lobes slightly unequal, ovate to obovate, hooded, glabrous or rarely papillose; upper lobe 1.2-2 mm long, obtuse at apex; lower 1.3-1.8 mm long, notched at apex. Corolla pink with a white tinge; upper lip up to 2.5 mm long, oblong, ciliate along lower lower margin, rounded or emarginate at apex; lower lip c 1.3 x 2 mm, shallowly 3-lobed, raised at base; spur up to 2.5 mm long, straight, horizontal, notched at apex. Stamens c 0.9 mm long; filaments flattened, curved, 1-nerved; anther thecae distinct. Pistil c 0.9 mm long; ovary obliquely ovoid; style short; stigma 2-lipped, lower lip short or obsolete, upper long and recurved. Capsules up to 2 mm long, obliquely ovoid, uniformly membranous; placenta c 1 mm long, ovoid. Seeds c 0.2 mm across, globose to obovoid; testa reticulate, cells large, more or less isodiametric. (Fig. 22; Photo 5C).

Fl. & Fr.: August-September (to December).

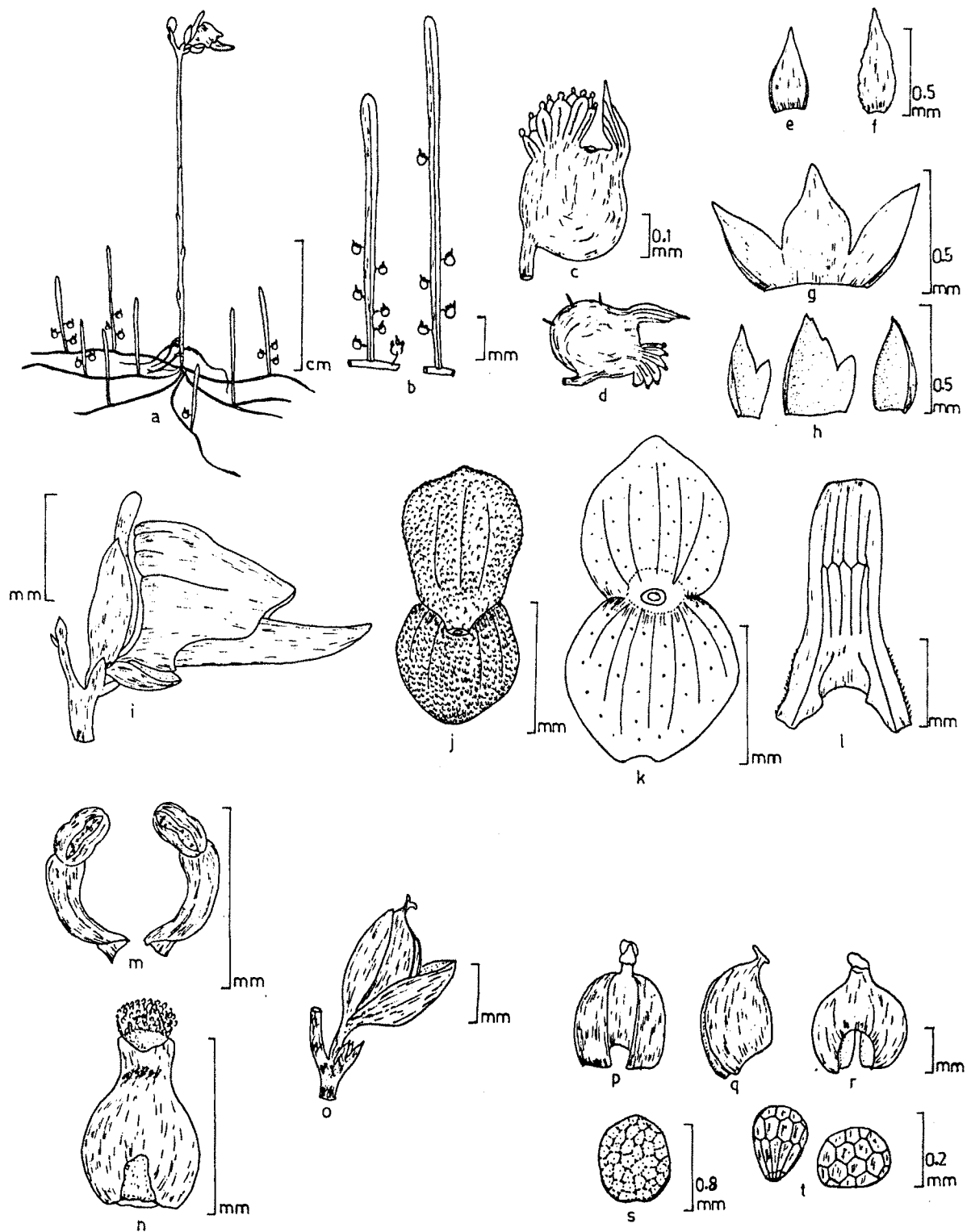


Fig. 22. *Utricularia minutissima* Vahl: a. Plant; b. Foliar organs; c, d. Traps; e, f. Scales; g, h. Bracts & bracteoles; i. Flower; j. Flowering calyx; k. Fruiting calyx; l. Corolla - upper lip; m. Stamens; n. Pistil; o. Fruit; p, q, r. Capsules (dehiscent); s. Placenta; t. Seeds.

Ecology: In wet sandy soil near water stagnant places; from sea-level to 500 m.

Distribution: India to Japan and South to Australia; in India distributed in Uttar Pradesh, W. Bengal, Orissa, Tamil Nadu, Karnataka and Kerala. (Map 6).

Pollen: Isopolar, tricolporate; 3-lobed in polar view, elliptic in equatorial view. Longiaxe pollens $24-26 \times 17-18 \mu$; breviaxe pollens $20 \times 22 \mu$ (Thanikaimoni 1966).

Notes: Utricularia minutissima Vahl is related to U. hirta Klein ex Link. But the former can be distinguished by its reddish brown inflorescence, absence of septate hairs, and uniformly membranous capsule.

According to Subramanyam (l.c.) the range of colours noticed in flowers pink, blue, violet to white - is perhaps due to the difference in the habitat and type of soil.

Specimens examined:

KERALA: Calicut dist., Badagara, Iringal, Sept. 1966, R. Vasudevan Nair s.n. (MH), 25.8.1985, M.K. Janarthanam 82934 (MH); Palghat dist., Malampuzha, 15.9.1985, M.K. Janarthanam 82939 (MH).

ORISSA: Nuanai bridge, Balukhand R.F., Oct. 1965, V. Abraham 264, 354 (BLAT).

TAMIL NADU: Tiruchirappalli dist., Narthamalai, 125 m, 23.9.1965, K. Ramamurthy 25943 (MH); Tirunelveli dist., Courtallam - Main falls, 433 m, 19.12.1957, K. Subramanyam 5035 (MH).

UTTAR PRADESH: Rajpur, 950 m, 1.10.1961, Saxena 2327B
(DD).

20. *Utricularia multicaulis* Oliver in J. Proc. Linn. Soc., Bot. 3: 188. 1859; Clarke in Hook.f. Fl. Brit. India 4: 334. 1884; Smith & Cave in Rec. Bot. Surv. India 4. 230. 1911; Smith in Rec. Bot. Surv. India 4: 403. 1913; Taylor in Hara, Enum. Fl. Pl. Nepal 3: 132. 1982, excl. syn. - LECTOTYPE: "1" Sikkim, (K, Photo !). (Taylor in Herb. Kew). (Photo 15).

Herbs; rhizoids and stolons not seen. Foliar organs more or less orbicular with a pseudopetiole. Racemes up to 5 cm long, tufted, erect, glabrous, 1-3-flowered; bracts c 1 mm long, medifixed, elliptic-lanceate, truncate to trifid at base, acute at apex; bracteoles up to 1 mm long, medifixed, elliptic-lanceate, truncate to bifid at base, acute at apex; flowers c 3 mm long; pedicels c 5 mm long, erect in anthesis, recurved in fruiting. Calyx-lobes unequal; upper lobe c 1.5 x 2 mm, suborbicular, emarginate at apex; lower 1 x 0.7 mm, obovate to oblong, emarginate to minutely denticulate at apex. Corolla flesh-coloured; upper lip c 1 mm long, semiorbicular, entire to emarginate at apex; lower c 2 mm across, 3-4-lobed, rarely 6-lobed, yellow in throat; spur 2 mm long, conical to cylindrical, straight or slightly curved, obtuse at apex. Stamens not seen. Pistil c 1 mm long; ovary ovoid; style short, thick; stigma 2-lipped. Capsules c 1.5 mm across, subglobose,

dehisce ventrally by a vertical slit; placenta connecting base and apex of capsule. Seeds up to 0.8 mm long, ovoid, appendicular at one end; hilum subterminal; testa echinate in definite rows. (Fig. 18 l-r).

Fl. & Fr.: July-August.

Ecology: Distributed in hill ranges between 1800 and 4800 m, as an epiphyte or terrestrial.

Distribution: Endemic to Eastern Himalayas; in India distributed only in Sikkim. (Map 7).

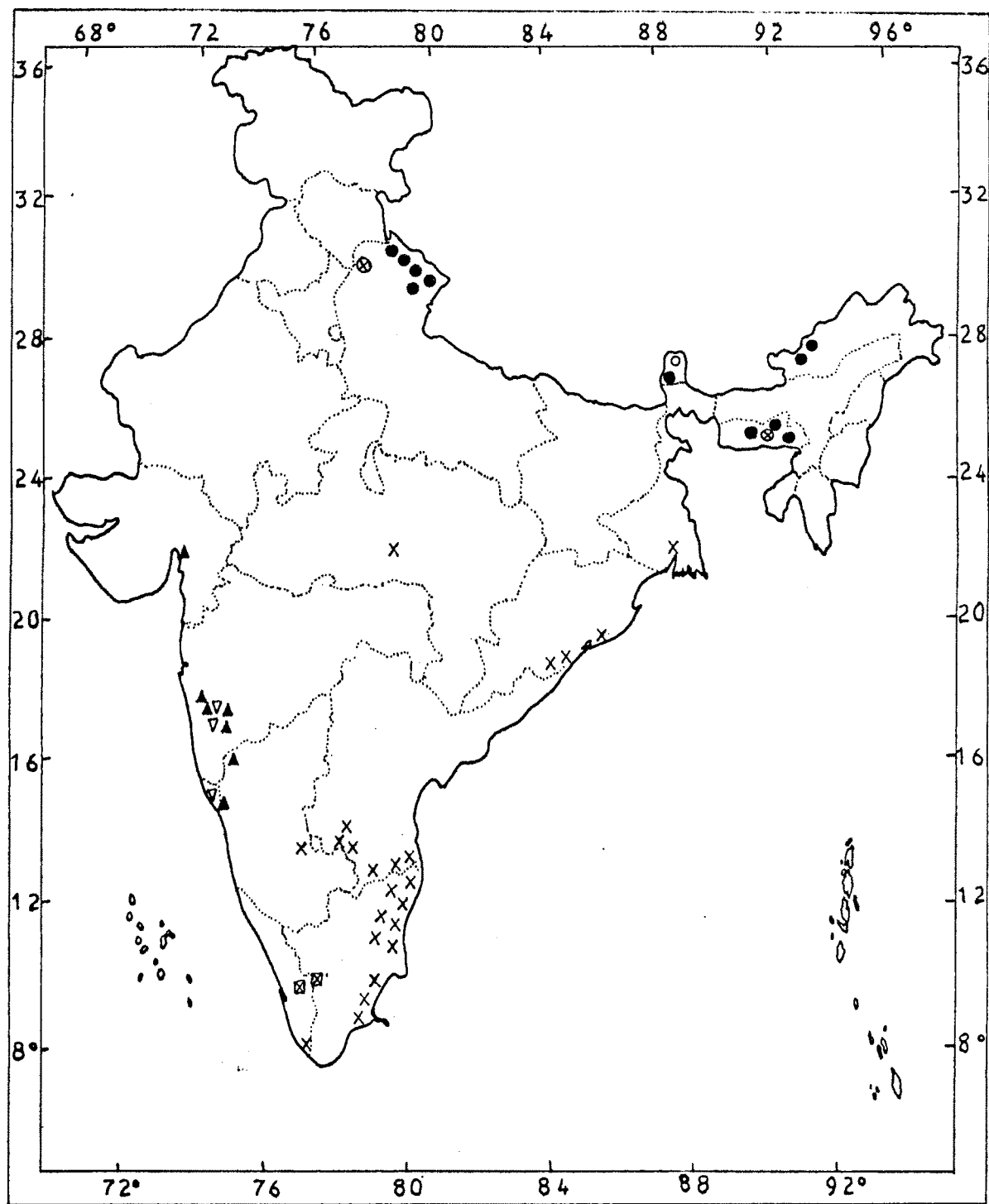
Pollen: Isopolar, tricolporate or tetracolporate, circular in polar view, elliptic in equatorial view; 25 x 31 μ (Thanikaimoni 1966).

Notes: Utricularia kumaonensis Oliver was included in U. multicaulis Oliver by Taylor (l.c.). But the seeds of U. multicaulis have prominent hilum and appendages confined to only one end of the seed, whereas in U. kumaonensis the hilum is not prominent and the appendages are distributed on both ends of seeds. U. multicaulis has not been collected after 1909.

Taylor (in Herb. Kew) has chosen "1" Sikkim as the lectotype of this species.

Specimens examined:

SIKKIM: 8-10,000 ft., J.D. Hooker s.n. (CAL, Acc. no. 330366), Tanya, 15,500 ft., 13.8.1909, Smith & Cave 2391 (CAL).



Map 7. Distribution: ○ *Utricularia multicaulis* Oliver
 ◻ *U. nayarii* M.K. Janarthanam & A.N. Henry
 x *U. polygaloides* Edgew.
 ▽ *U. praeterita* Taylor
 ⊗ *U. pubescens* Smith
 ▲ *U. purpurascens* Graham
 ● *U. recta* M.K. Janarthanam

21. *Utricularia nayarii* M.K. Janarthanam & A.N. Henry in Bull. Bot. Surv. India 28: 195. 1986 (1988). - HOLOTYPE: INDIA. Kerala, Idukki dist., Rajamallay, 12.12.1985, M.K. Janarthanam 82963 (CAL !). (Photo 16).

Herbs; rhizoids up to 2 cm long, c 0.25 mm thick at base, glandular; branches up to 4 mm long, simple or branched further, papillose; stolons up to 3 cm long, c 0.2 mm thick, sparsely branched. Foliar organs up to 5 cm long, 1-2.5 mm wide, linear, solitary at peduncle base and scattered on stolons, 3-nerved, nerves branched further, rounded at apex. Traps 1-1.5 mm across, globose; stalk distally thickened; mouth basal; appendages 2, subulate, simple, glandular. Racemes up to 18 cm long, c 0.6 mm thick, angular, grooved on one side, glabrous, 1-5-flowered; scales similar to bracts; bracts up to 2.2 x 1.8 mm, basifixed, broadly ovate-deltoid, 1-nerved, acuminate at apex; bracteoles up to 1.8 mm long, subulate; flowers up to 8 mm long; pedicels 3-5 mm long, winged, erect at anthesis, spread in fruit. Calyx-lobes unequal; upper lobe 2.5-5 x 3-4 mm, broadly ovate, acuminate at apex; lower 2.8-6 x 2.2-3.3 mm, linear-ovate in flower, more or less elliptic in fruit, bi- or tridentate at apex. Corolla white to violet; upper lip 4-4.5 mm long, more or less oblong, constricted at middle, rounded to emarginate at apex; lower lip 4.5-7.5 x 5-7 mm, suborbicular to obovate, hairy in throat, gibbous at base, rounded-wavy at apex; spur shorter than or equal to calyx-lobe in length, conical, obtuse or notched at

apex, glandular within. Stamens c 1.2 mm long; filaments strap-shaped, slightly curved; anther thecae distinct. Pistil c 1.3 mm long; ovary ovoid, dorsiventrally compressed; style short; stigma bilipped, lower lip truncate, upper semiorbicular. Capsules c 3 x 2 mm, ovoid, wall uniformly membranous, dehiscing by a dorsal and a ventral longitudinal slits; placenta c 1.5 mm long, ovoid. Seeds c 0.5 mm across, few, subglobose, often angled; testa thick, scrobiculate, reticulate, cells more or less isodiametric. (Fig. 23).

Fl. & Fr.: October-December.

Ecology: A terrestrial plant, on dripping rocks laden with moss, in association with Eriocaulon and Impatiens spp. and grasses; above 1650 m.

Distribution: Restricted to Idukki district of Kerala and Kodaikanal of Tamil Nadu. (Map 7).

Notes: Utricularia nayarii M.K. Janarthanam & A.N. Henry is allied to U. graminifolia Vahl, but distinct in its shorter spur, uniformly membranous capsule and scrobiculate testa with more or less isodiametric cells. This species shows somewhat thick, fleshy foliar organs when compared with other species of Utricularia.

Specimens examined:

KERALA: Idukki dist., Lockhart gap - Devicolam, 1675 m, 12.10.1963, K.M. Sebastine 17543, 17545 (CAL, MH paratypes), Pettimudi, 12.12.1985, M.K. Janarthanam 82961, 82962 (MH), Rajamally, 12.12.1985, M.K. Janarthanam 82963

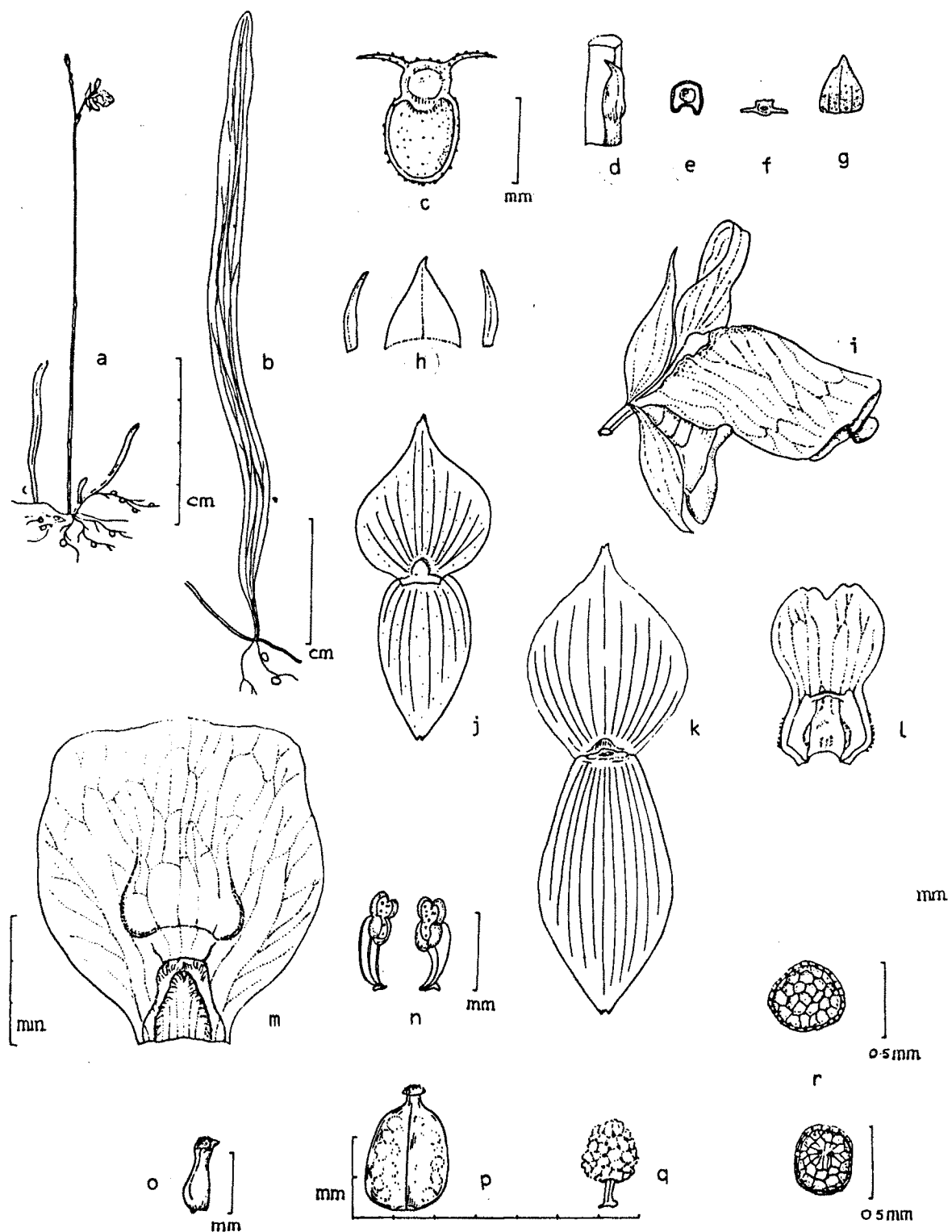


Fig. 23. *Utricularia nayarii* M.K. Janarthanam & A.N. Henry sp. nov.: a. Plant; b. Foliar organ; c. Trap; d. Scale attached to peduncle; e. T.S. of scape; f. T.S. of pedicel; g. Scale; h. Bract & bracteoles; i. Flower; j. Calyx (flower); k. Calyx (fruit); l. Corolla - upper lip; m. Corolla - lower lip; n. Stamens; o. Pistil; p. Capsule; q. Placentum; r. Seeds.

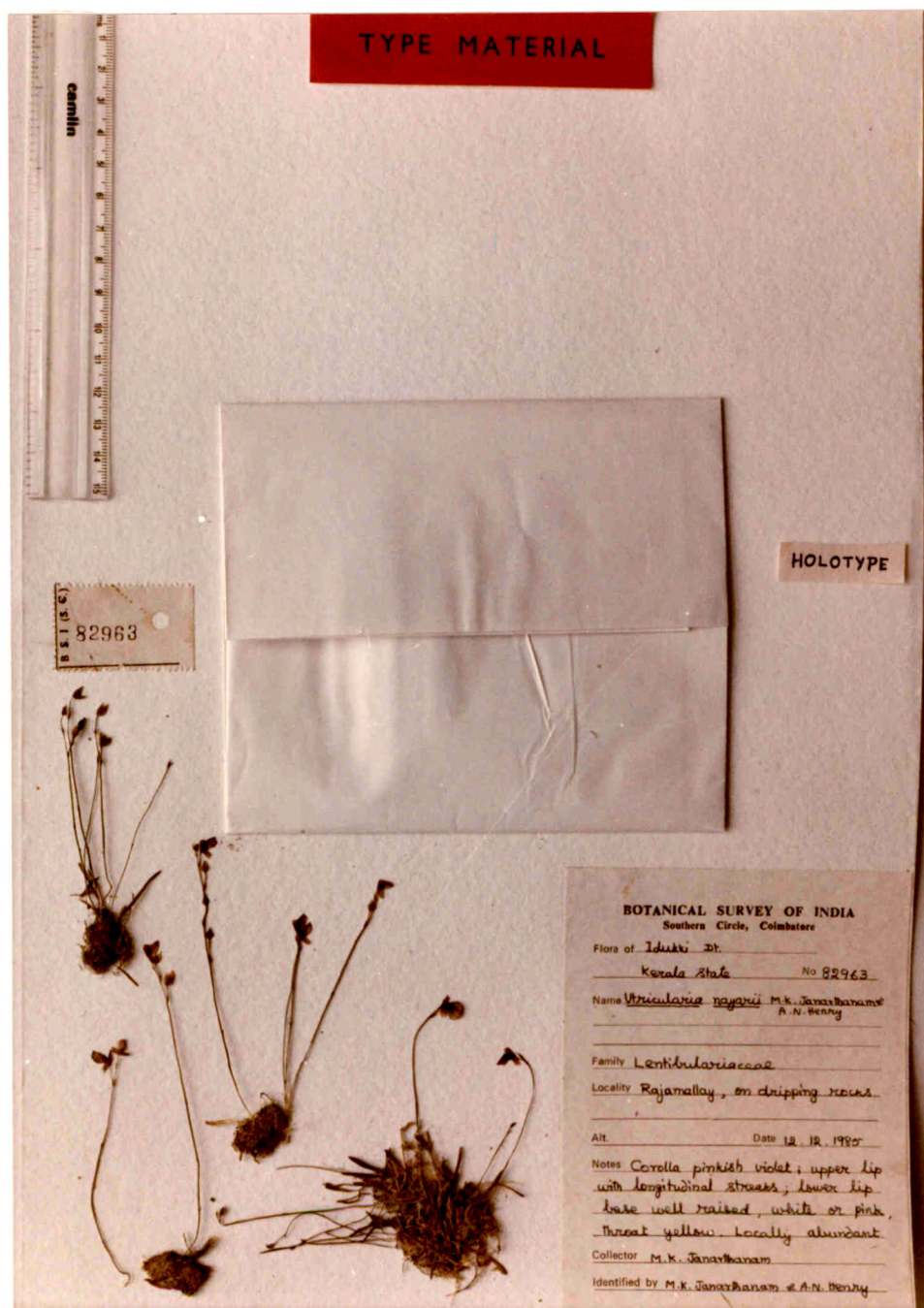


Photo 16. *Utricularia nayarii* M.K. Janarthanam & A.N. Henry
sp. nov. (Holotype - CAL).

(CAL, MH Type), Lockhart gap, 13.12.1985, M.K. Janarthanam 82969 (MH), Eravikulam National Park, 3.12.1987, M.K. Janarthanam 83050, 83051, 83052, 83053 (MH).

TAMIL NADU: Anna dist., Kodaikanal, Levinge, 6,700 ft., 25.8.1959, C. Saldanha CS 4247 (BLAT).

22. *Utricularia polygaloides* Edgew. in Proc. Linn. Soc. London 1: 351. 1848; Basak in Bull. Bot. Surv. India 17: 103. 1975 (1978) & in Taxon 25: 189. 1976; Bhattacharyya in Bull. Bot. Soc. Bengal 30: 77. 1976 (1978); Rani & Matthew in Matthew, Fl. Tamilnadu Carnatic 3: 1118. 1983; Srivastava in J. Econ. Tax. Bot. 4: 190. 1983; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 130. 1987. - NEOTYPE: INDIA. W. Bengal, Burdwan, January 1837, Mrs. Skepwith s.n. Acc. no. 330152 (CAL !) (Basak l.c.).

Utricularia reticulata Smith var. *stricticaulis* Koenig ex Oliver in J. Proc. Linn. Soc., Bot. 3: 180. 1859. - TYPE: "In Ceylonia, Walker ! (C.P. 2088), Thwaites ! Coromandel, Koenig & c. !, Mysore, hb. wall. !" (BM, K).

Utricularia reticulata Smith var. *uliginosa* Clarke in Hook. f. Fl. Brit. India 4: 331. 1884, non *U. uliginosa* Vahl 1804; Prain, Bengal Pl. 2: 781. 1903 (2: 582. 1963 repr. ed.) & in Rec. Bot. Surv. India 3: 254. 1905; Haines, Bot. Bihar Orissa 3 & 4: 645. 1922 (2: 677. 1961 repr. ed.).

Utricularia stricticaulis (Koenig ex Oliver) Stapf ex Gamble, Fl. Madras 981. 1924 (2: 689. 1957 repr. ed.); Barnes, Suppl. Fl. Pl. Madras 29. 1938; Abraham & Subramanyam

in Proc. Indian Acad. Sci. 62B: 98. 1965; Sharma et al. Fl. Karnataka 196. 1984. - TYPE: as in U. reticulata Smith var. stricticaulis Koenig ex Oliver.

Utricularia humilis sensu Wight, Ic. t. 1572. f. 2. 1850, non Vahl 1804.

Herbs; rhizoids up to 3 cm long, c 0.5 mm thick at base, glandular; branches 1-3 mm long, papillose; stolons up to 2 cm long, glandular, sparsely branched. Foliar organs up to 12 x 0.5 mm, linear, solitary at scape base and scattered on stolons, 1-nerved, acute to obtuse at apex. Traps up to 1 mm across, globose; stalk distally thickened, glandular hairy; mouth basal; appendages 2, simple, subulate, hairy. Racemes up to 26 cm long, c 1.5 mm thick, tapering at base, terete, glabrous, up to 12-flowered; scales c 1 mm long, basifixed, ovate to lanceate, 1, 3- or 5-nerved, acute to obtuse at apex; bracts up to 3 mm long, basifixed, broadly ovate, 3- or 5-nerved, acute to acuminate at apex; bracteoles 1-2 mm long, basifixed, subulate, 1-nerved; flowers up to 9 mm long. Calyx-lobes 3-3.7 x 2-4.2 mm, ovate to lanceate; upper lobe acute to acuminate at apex; lower lobe bi- or tridentate or rarely acuminate at apex. Corolla violet with white streaks; upper lip 4-4.5 x 2-3 mm long, oblong or obovate, obtuse at apex; lower lip 5-6 x 3-4 mm, obovate, hairy in throat, raised and gibbous at base, rounded or emarginate at apex; spur more or less equal to calyx-lobe in length, conical, pointing downwards, acute at apex. Stamens 1.5-2 mm long;

filaments strap-shaped, 1-nerved; anther thecae distinct. Pistil 1.5-2 mm long; ovary ovoid, compressed, slightly curved; style distinct; stigma bilipped, upper lip reduced or 3-denticulate, or distinct and oblong, lower lip semi-orbicular and recurved. Capsules 3-6 x 2.5-3.5 mm, ovoid, compressed, dehisce by marginally thickened vertical slits on both sides; placenta 2.5-3.2 x 2.2-2.7 mm, compressed, rectangular in outline. Seeds c 0.3 mm long, ellipsoid; hilum distinct, subterminal or lateral; testa reticulate, cells elongated and finely striated within. (Fig. 24).

Fl. & Fr.: November to February.

Ecology: Wet or water logged sandy areas like wastelands, sea-shore etc., rarely in gravelly ground and rocky areas; from sea-level to 600 m.

Distribution: India and Sri Lanka; in India recorded from W. Bengal, Orissa, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka and Kerala. (Map 7).

Chromosomes: $n = 7$ (Subramanyam and Kamble 1968).

Pollen: Isopolar, tetracolporate or pentacolporate, 4-5-lobed in polar view, elliptic in equatorial view, 23-26 x 28-30 μ (Thanikaimoni 1966).

Notes: The identity of Utricularia polygaloides Edgew. is often confused with U. bifida L. in fruiting condition. But the former can be distinguished by its acute to acuminate apices of calyx lobes, thickened margin along the dehiscence of capsule, and non-recurved fruiting pedicel.

The distribution of this species in India is along the East Coast and interior plains of peninsular India. Interestingly its allied species U. reticulata Smith is distributed along the West Coast and W. Ghats.

Specimens examined:

ANDHRA PRADESH: Nellore dist., Tada 13.3.1901, Bourniere 2158 (CAL, MH); Kambakkam hills, 6.5.1913, C.A. Barber 8949 (MH); Tada, 12.1.1958, S.K. Wagh, SKW 7201-7203 (BLAT); 31.8.1958, P.B. Kamath 702 (PCM); Cuddapah dist., Balapalle, 23.2.1963, J.L. Ellis 15772 (CAL, MH); Kurnool dist., Sunnipentavara, Srisailam-Nellamalais, 15.7.1963, J.L. Ellis 16893 (CAL, MH), 21.10.1964, J.L. Ellis 22128 (MH); Chittoor dist., Kailasakona, 26.6.1969, G.V. Subba Rao 32023 (CAL, MH); Anantapur dist., Garugudukona, 21.12.82, T. Pullaiah 952 (MH).

KERALA: Trivandrum dist., Bonaccord estate, 9.10.1973, J. Joseph 44649 (MH).

ORISSA: Ganjam, Gopalpur, Sand dune, 19.12.1889, D. Prain s.n. (CAL, Acc. no. 330150), Chatrapur, Dec. 1889, J.S. Gamble 21561 (BSI, CAL, DD); Puri Coast, 2.12.1965, T.A. Rao 5697 (CAL).

TAMIL NADU: Madras, Paddy fields, Mar. 1883 Lawson, s.n. (MH, Acc. no. 36652); Madras, Elliots Beach, Jan. 1919, P.F. Fyson 5571 (BLAT, PCM); Thanjavur dist., Puduthorai, 11.12.1931, V. Narayanaswamy s.n. (MH, Acc. no. 80758); Chengalpattu dist., Mahabalipuram, 14.2.1960, E. Govindarajulu 3768 (PCM); Ramanathapuram dist., Sivaganga, Esani

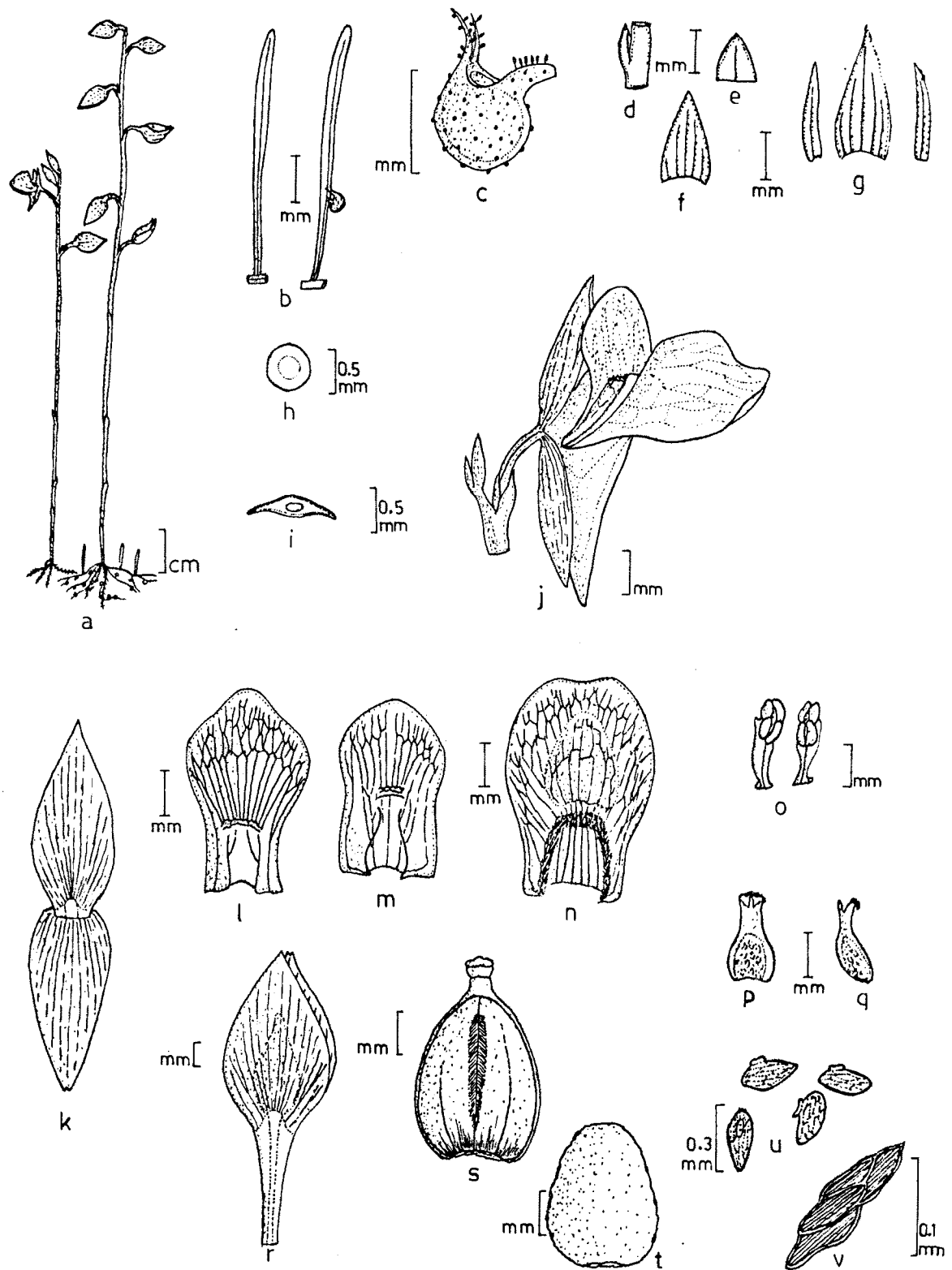


Fig. 24. *Utricularia polygaloides* Edgew.: a. Plants; b. Foliar organs; c. Trap; d. Scale on scape; e, f. Scales; g. Bract & bracteoles; h. T. S. of scape; i. T.S. of pedicel; j. Flower; k. Calyx; l, m. Corolla - upper lip; n. Corolla - lower lip; o. Stamens; p. Pistil - adaxial view; q. Pistil - lateral view; r. Fruit; s. Capsule; t. Placentum; u. Seeds; v. Testa cells.

Forest, 16.12.1964, K. Ramamurthy 22730 (MH); Chengalpattu dist., Tirupporur R.F. 1.2.1976, A.N. Henry 47144 (CAL, MH); South Arcot dist., Gingee, Karai R.F., 20.1.1978, K. Ramamurthy 52866 (CAL, MH); Pudukkottai dist., Siddannavasal, 2.2.1978, K. Ramamurthy 53743 (CAL, MH); South Arcot dist., Marakkanam to Kurumapuram R.F., 17.2.1979, K. Ramamurthy 60251 (CAL, MH); Chengalpattu dist., Sunnambukulam, 10.1.1986, M.K. Janarthanam 82973 (MH); North Arcot, Veerambakkam, 16.1.1986, M.K. Janarthanam 82976 (MH).

W. BENGAL: Hooghly, Vickdas's field, 23.11.1961, Prabhat Hazra 139 (CAL).

23. *Utricularia praeterita* Taylor in Matthew, Fl. Tamilnadu Carnatic 3: 1120. t. 87. 1983 quoad Holotypus. - HOLOTYPE: INDIA. Maharashtra, Panchgani, P. Taylor 18104 (K, Photo!). (Photo 17).

Herbs; rhizoids up to 1 cm long, c 0.2 mm thick, glandular, branches c 1 mm long, papillose; stolons up to 2 cm long, c 0.15 mm thick, glandular, sparsely branched. Foliar organs up to 10 x 1.5 mm, spatulate to obovoid, 3-nerved, rounded at apex. Traps up to 1.5 mm across, subglobose, slightly compressed; stalk evenly thickened or distally thickened; mouth basal; appendages 2, simple, subulate, glandular. Racemes up to 18 cm long, slightly grooved, winged, glabrous, 1-7-flowered; scales up to 1 mm long, basifixed, lanceate to suborbicular, 1-nerved (rarely nerves absent), acute to obtuse at apex; bracts

up to 1.6 mm long, basifixed, broadly ovate-deltoid to semiorbicular, usually 1-nerved (rarely nerves absent), acuminate at apex; bracteoles up to 1 mm long, basifixed, linear, acuminate at apex; flowers 6-7 mm long; pedicels 1.2-5 mm long, winged, erect or spread. Calyx-lobes subequal, papillose without, denticulate along margins; upper lobe 2-2.5 x 2-3 mm (2-5 x 2-4 mm in fruit), broadly ovate, acuminate to obtuse or rarely bi- or tridentate at apex; lower lobe 2-2.3 x 1.6-2 mm (2-4 x 1.6-3.3 mm in fruit), ovate, bidentate to bifid at apex. Corolla violet; upper lip c 3 mm long, oblong, constricted near middle, crested across at middle, shallowly emarginate to truncate at apex; lower lip 3.5-5 x 3-3.5 mm, obovate to suborbicular, hairy in throat, gibbous at base, rounded or slightly 3-4-lobed at apex; spur c 3.5 mm long, descending, papillose and glandular within, acute at apex. Stamens 1.2 mm long; filaments strap-shaped; anther thecae distinct. Pistil c 1.2 mm long; ovary ovoid, slightly compressed; style small; stigma bilipped, lower lip orbicular recurved, upper lip obsolete. Capsules ovoid, 2-3 x 1.3-2 mm, slightly compressed, dehisce ventrally by a vertical slit; placenta 1.4-1.7 x 0.7-1.2 mm, obovoid to ellipsoid. Seeds 0.3-0.4 mm long, ellipsoid; hilum lateral or latero-terminal, distinct; testa reticulate, cells narrow, elongated, compact, often obliquely arranged. (Fig. 25).

Fl. & Fr.: August-October.

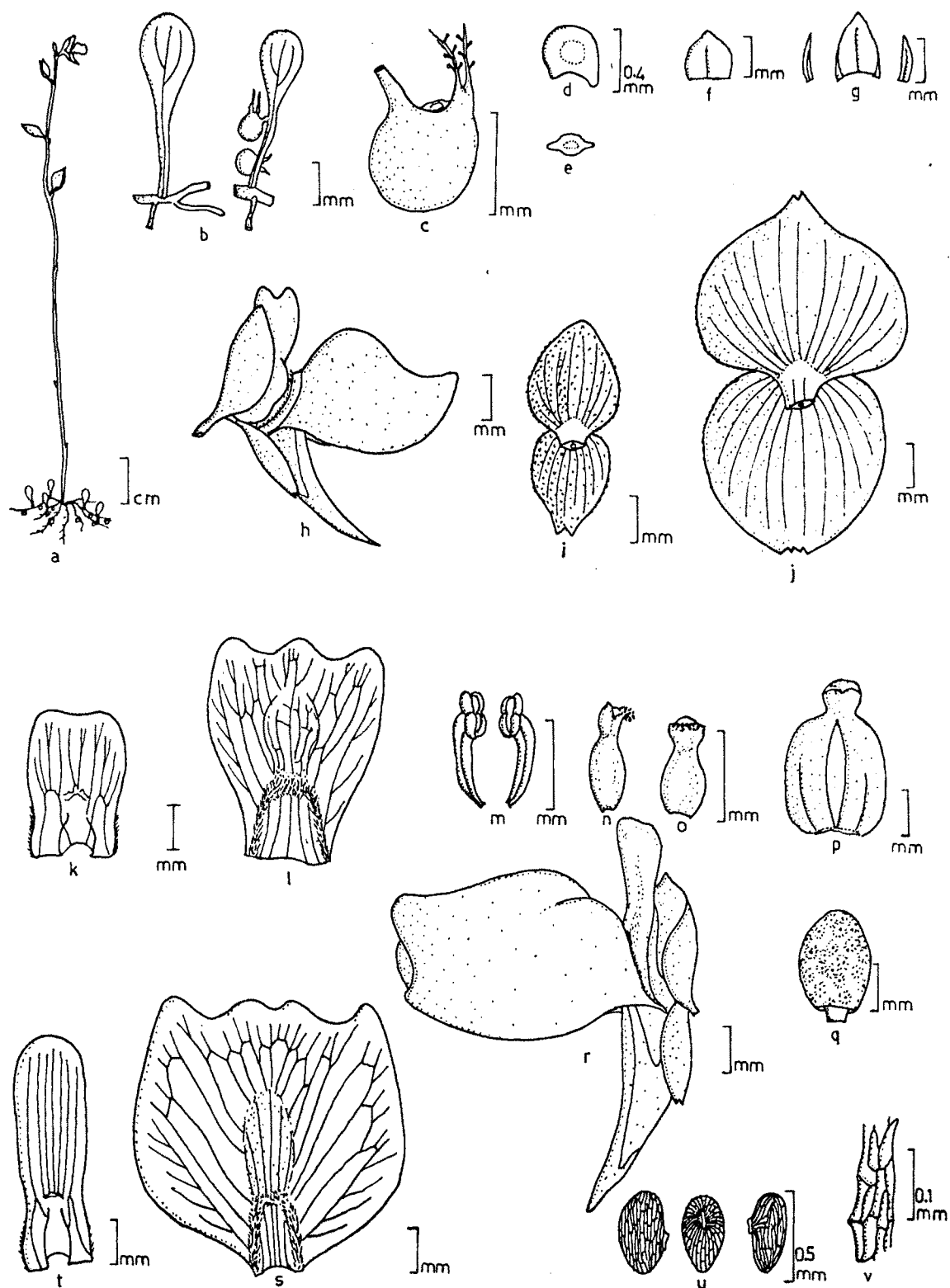


Fig. 25. *Utricularia praeterita* Taylor: a. Plant; b. Foliar organs; c. Trap; d. T.S. of scape; e. T.S. of pedicel; f. Scale; g. Bract & bracteoles; h, r. Flower; i. Flowering calyx; j. Fruiting calyx; k, t. Corolla - upper lip; l, s. Corolla - lower lip; m. Stamens; n. Pistil - lateral view; o. Pistil - adaxial view; p. Capsule; q. Placenta; u. Seeds; v. Testa cells.

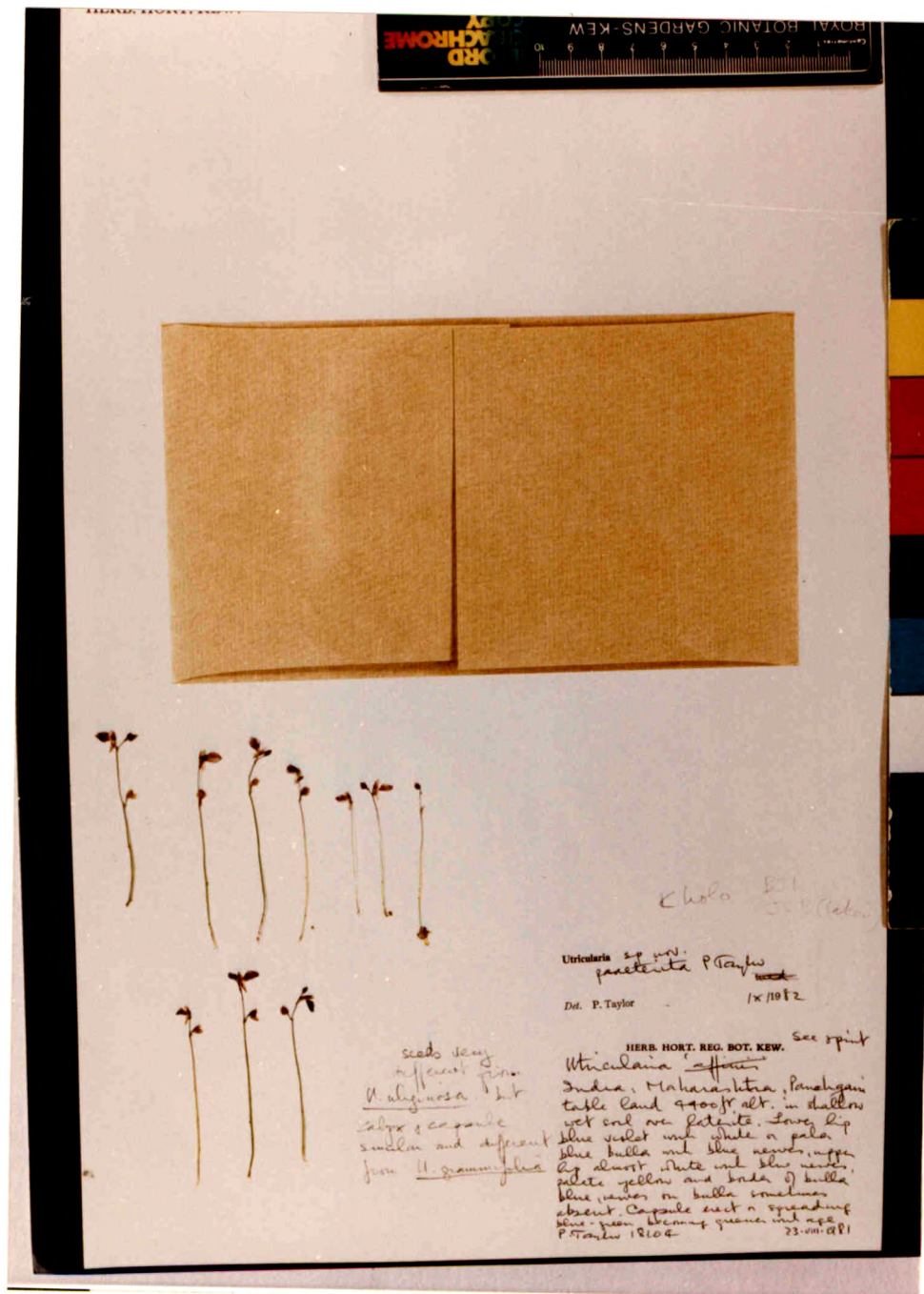


Photo 17. *Utricularia praeterita* Taylor (Holotype - K).

Ecology: Along streamlets, dripping rocks, and marshy places near waterfalls in hills; associated with grasses, and species of Eriocaulon, Drosera, Rhamphicarpa, and Utricularia purpurascens Graham.

Distribution: Endemic to Goa and Maharashtra of W. India. (Map 7).

Notes: Specimens referred to Utricularia praeterita Taylor from Tamil Nadu in the protologue are the extreme forms of U. uliginosa Vahl. Since the original description is based only on the type materials (Holotype Taylor 18104 K) from Panchgani, Maharashtra there is no ambiguity regarding the application of the name - U. praeterita Taylor.

Deeply bidentate fruiting calyx-lobes, ellipsoid seeds with lateral or latero-terminal hilum and much elongated testa cells of U. praeterita readily differentiate it from its ally U. uliginosa which has obtuse or minutely bi- or tridentate lower fruiting calyx-lobes, globose to sub-globose seeds with terminal hilum and more or less isodiametric to slightly elongated cells.

Specimens examined:

GOA: Vasco-Navy Office plateau, 20.8.1963, K.C. Kano-dia 89401 (BSI).

MAHARASHTRA: Satara dist., Mahableshwar, Ludwig point, 11.10.1960, M.Y. Ansari 67638 (BSI); Khed taluk, 9.10.1962, K.P. Janardhanan 81733 (BSI); Mahableshwar, near Venna lake, 5.10.1985, M.K. Janarthanam 82943 (MH), Lingmalla falls, 8.10.1985, M.K. Janarthanam 82947, 82950 (MH), Venna

lake, 9.10.1985, M.K. Janarthanam 82952 (MH), Pune dist., Varshava temple, Lonavala hill slopes, 11.10.1985, M.K. Janarthanam 82954 (MH), Ambavane Road, INS Sivaji, 12.10.1985, M.K. Janarthanam 82957 (MH), Bushy hills, 13.10.1985, M.K. Janarthanam 82960 (MH).

24. *Utricularia pubescens* Smith in Rees, Cyclop. 37: No. 53. 1819; Taylor in Kew Bull. 18: 101. 1964; Saxena in Indian Forester 91: 73. 1965; Rao & Joseph in Indian Forester 93: 32. 1967; Raizada in Suppl. Duthie's Fl. 194. 1976; Babu, Herb. Fl. Dehra Dun 368. 1977; Raizada & Saxena, Fl. Mussoorie 1: 527. 1978; Srivastava in J. Econ. Tax. Bot. 4: 190. 1983; Mukherjee, Fl. Pachmarhi Bori Res. 217. 1984; Joseph & Joseph, Insect. Pl. Meghalaya 23. 1986.-
TYPE: Sierra Leone, Afzelius s.n. (BM, BR, LINN, S).

Herbs; rhizoids few, capillary, simple; stolons up to 2 cm long or more, sparsely branched. Foliar organs with pseudopetiole up to 8 mm long, peltate, at scape base and on stolons; peltate portion up to 2 mm across, orbicular, nerves dichotomously divided. Traps c 1 mm long, globose to obovoid, on vegetative organs; stalk evenly thickened; mouth terminal; appendages of gland-tipped hairs arranged on lips in rows in a comb-like pattern. Racemes up to 5 cm long, filiform, papillose, 1-5-flowered; scales similar to bracts; bracts c 1.5 mm long, basisolute, linear to lanceate, papillose to pubescent, acute at apex; bracteoles c 1 mm long, basisolute, linear; flowers up to 7 mm

long; pedicels c 0.9 mm long, erect, terete. Calyx-lobes unequal in fruiting, papillose; upper lobe c 1 x 0.8 mm (c 1.4 x 1.1 mm in fruit), ovate, acute at apex; lower lobe 1 x 0.8 mm (c 1.2 x 1.4 mm in fruit), broadly ovate to suborbicular, bidentate at apex. Corolla mauve to bluish purple; upper lip c 3.5 mm long, more or less oblong, papillose to ciliate at lower margins, rounded or truncate at apex; lower lip c 3.5 x 2.5 mm, variable in shape, gibbous and double crested at base, rounded or 3-lobed at apex; spur 4-6 mm long, obtuse at apex. Stamens c 1 mm long; filaments strap-shaped, curved; anther thecae distinct. Pistil c 1 mm long; ovary ovoid; style distinct; stigma 2-lipped, lower lip semiorbicular, upper lip oblong. Capsules 1-2 mm across, subglobose, attached obliquely to upper calyx-lobe, dehisce ventrally by a longitudinal slit; placenta c 0.4 mm long, ellipsoid. Seeds c 0.2 mm long, obovoid; testa reticulate, cells elongated to more or less isodiametric at distal end. (Fig. 26a-j).

Fl. & Fr.: July-October.

Ecology: Open marshy places, among mosses and grasses or along streamlets above 900 m.

Distribution: South America, Tropical Africa and India; in India recorded in Uttar Pradesh, Meghalaya and Madhya Pradesh. (Map 7).

Pollen: 7- or 8-aperture; 30 x 30 μ (Huynh 1968).

Notes: Utricularia pubescens Smith can be identified with the help of its foliar organs, which are peltate.

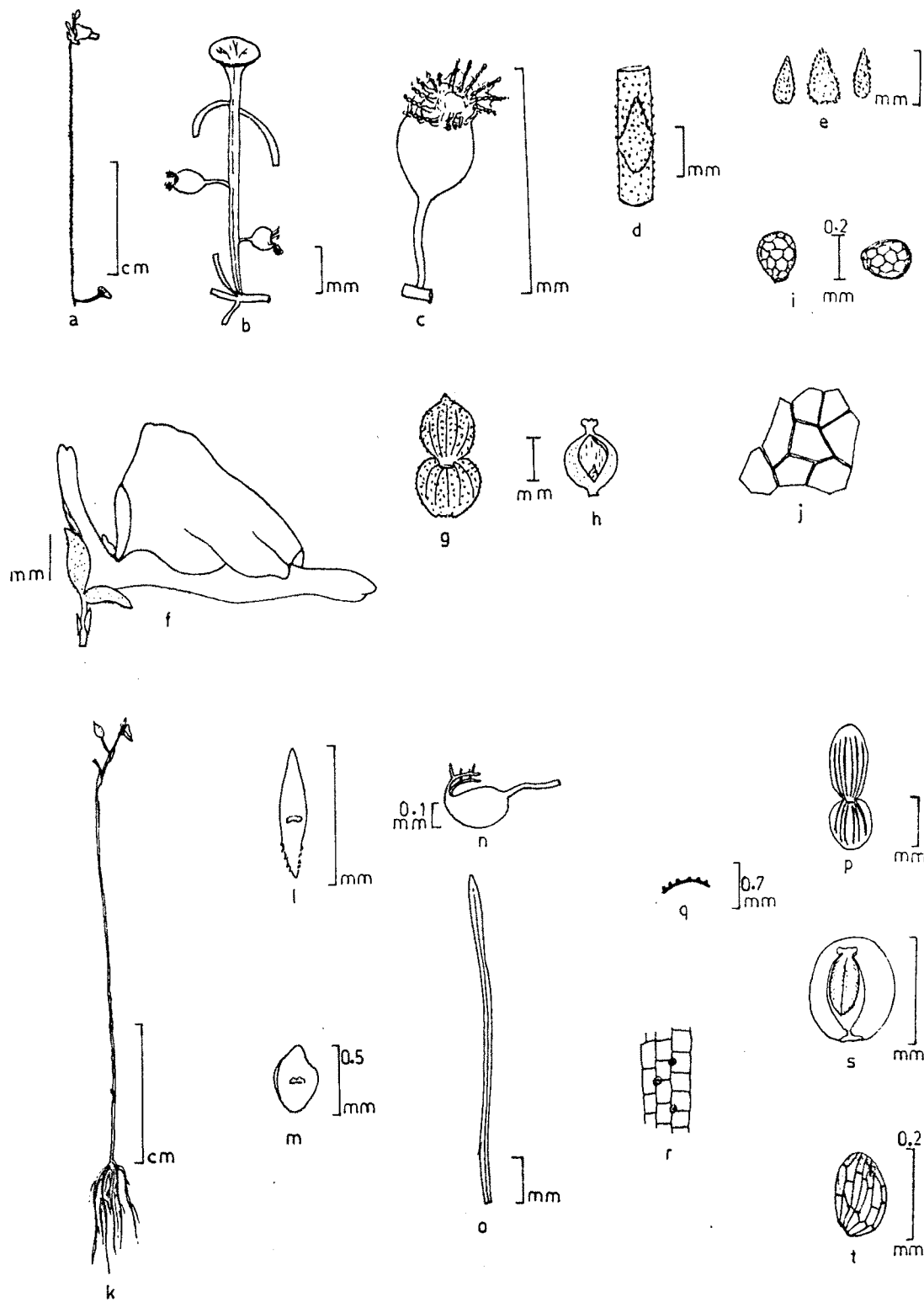


Fig. 26. *Utricularia pubescens* Smith (a-j): a. Plant; b. Foliar organ with traps; c. Trap; d. Scale on scape; e. Bract & bracteoles; f. Flower; g. Calyx; h. Capsule; i. Seeds; j. Testa cells.

Utricularia subulata L. (k-t): k. Plant; l. Scale; m. Bract; n. Trap; o. Foliar organ; p. Calyx; q. T.S. of Calyx-lobe (showing prominent nerves); r. Glands inside spur; s. Capsule - dehiscent; t. Seed.

Taylor (1964) states that "the upper surface of the leaves, at least when they are young, is covered with a layer of mucilage, but it is not known whether this provides a second method of trapping small organisms, similar to that found in "Pinguicula".

Specimens examined:

MEGHALAYA: Barapani, 1000 m, 16.8.1966, A.S. Rao 45172 (ASSAM).

UTTAR PRADESH: Dehra Dun, Rajpur, 950 m, 1.10.1961, H.O. Saxena 2327 (DD, Acc. no. 140608), 2327A (DD, Acc. no. 145192), Rajpur Road, 11.11.1976, A.S. Rao 53721 (BSD).

25. *Utricularia purpurascens* Graham, Cat. Pl. Bombay 165. 1839; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 130. 1987; Janarthanam & Henry in J. Econ. Tax. Bot. 10: 245. 1987. - NEOTYPE: INDIA. Maharashtra, Satara dist., Mahableshwar, 5.10.1985, M.K. Janarthanam 82941 (MH). (Janarthanam & Henry 1987). (Photo 18).

Utricularia arcuata Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849 & Ic. t. 1571. f. 1. 1850; Oliver in J. Proc. Linn. Soc., Bot. 3: 177. 1859; Dalzell & Gibson, Bombay Fl. 136. 1861; Drury, Handb. Ind. Fl. 2: 121. 1866; Clarke in Hook.f. Fl. Brit. India 4: 330. 1884; Cooke, Fl. Bombay 2: 318. 1905 (2: 391. 1958 repr. ed.); Saxton in Rec. Bot. Surv. India 9: 257. 1922; Santapau in J. Bombay Nat. Hist. Soc. 49: 218. 1950 & in Rec. Bot. Surv. India 16: 188. 1967; Shah, Fl. Gujarat 1: 514. 1978; Raghavan

et al. Rec. Bot. Surv. India 21: 63. 1981; Sharma et al. Fl. Karnataka 195. 1984; Rao, Fl. Goa 2: 308. 1986. - HOLOTYPE: Belgaum, Lawson 73 (K, Photo !).

Herbs; rhizoids up to 2 cm long, c 0.5 mm thick at base, glandular, branches 1-4 mm long, papillose; stolons up to 3 cm long, c 0.2 mm thick, sparsely glandular, branched. Foliar organs up to 7.5 x 2 mm, spatulate, at scape base and on stolons, 3-nerved, rounded at apex. Traps c 1 mm across, subglobose, slightly compressed, on vegetative organs; mouth basal; appendages 2, subulate, glandular. Racemes up to 25 cm long, c 1 mm thick, glabrous, 1-7-flowered; scales 1-2 x 1-1.5 mm, basifixed, ovate to oblong, 1-nerved, truncate at base, acute to acuminate at apex; bracts 1-2 x 1-1.5 mm, basifixed, ovate to oblong, 3-nerved, truncate at base, acuminate at apex; bracteoles c 1.2 mm long, linear, 1-nerved, acute at apex; flowers up to 14 mm long; pedicels up to 12 mm long, c 0.7 mm wide, winged, erect in flower, recurved in fruit. Calyx-lobes ovate, papillose; upper lobe 3.5-4 x 3.5-4 mm (5-5.5 x 5-6 mm in fruit), acute at apex; lower lobe 3.2-4 x 2.7-4 mm (5-5.5 x 4.8-5.2 mm in fruit), bidentate at apex. Corolla pink, white at base, yellow in throat; upper lip c 5.5 x 4 mm, papillose, upper limb obovate, lower limb quadrate, ciliate at lower margin, emarginate at apex; lower lip 8-15 mm across, more or less orbicular, hairy in throat, gibbous at base; spur 9-12 mm long, sickle-shaped, curved below lower lip. Stamens c 1.7 mm long; filaments strap-

shaped, curved; anther thecae distinct. Pistil c 2 x 1 mm; ovary ovoid; style short; stigma bilipped, lower lip semiorbicular, upper broadly triangular. Capsules 3-4 x 2.3-3 mm, ovoid, slightly compressed, dehisce by a ventral, marginally thickened vertical slit. Seeds c 0.3 mm long, ellipsoid; hilum subterminal; testa reticulate, cells elongated and parallelly arranged. (Fig. 27).

Fl. & Fr.: August-October.

Ecology: On wet laterite rocks, soil covered black boulders and grassy slopes; associated with grasses, species of Eriocaulon, Rhamphicarpa, and Striga gesnerioides (Willd.) Vatke.

Distribution: Endemic to Northern parts of W. Ghats; distributed from Maharashtra to Gujarat in north, and to Karnataka and Goa in south. (Map 7).

Pollen: Isopolar, tetracolporate or pentacolporate, 4-5-lobed in polar view, elliptic in equatorial view; 25-27 x 27-28 μ (Thanikaimoni 1966).

Notes: Utricularia purpurascens Graham (l.c.) was validly published on the basis of materials observed in Mahabaleshwar. John Graham's catalogue, in general, did not deal with dried specimens in a herbarium. In the absence of original materials preserved in any of the herbaria, Janarthanam 82941 (MH) collected from the type locality after a lapse of about 150 years is designated as the neotype of this species.

Utricularia arcuata Wight (l.c.) described from the materials collected in Belgaum by Lawson (73, K) has since been proved conspecific with U. purpurascens Graham.

Utricularia purpurascens is allied to U. albocaerulea Dalzell, from which it can be differentiated by its characteristic sickle-shaped spur of the corolla. Fischer erroneously reported it from the Anamalais of Coimbatore; the specimen (in CAL) turned out to be only U. uliginosa Vahl.

Specimens examined:

GOA: Castle rock, 1600 ft., Aug. 1917, s.l. 2743 (BLAT).

GUJARAT: Junnar, Dhak plateau, 29.9.1965, K. Hemadri 107469 (BSI).

KARNATAKA: Belgaum, 2000 ft., 5.8.1896, W.A. Talbot 3760 (CAL).

MAHARASHTRA: Satara dist., Mahabaleshwar, 1884, T. Cooke 134 (CAL); Pune dist., Khandala, 4.9.1941, H. Santapau 151.2/500A (BLAT), 8.9.1941, H. Santapau 151.5/573(2) A (BLAT), 29.8.1942, H. Santapau 736 (BLAT), 13.9.1942, H. Santapau 924 (BLAT, DD), 11.10.1943, H. Santapau 2815 (BLAT), Kune plateau, 9.9.1944, H. Santapau 4856 (BLAT), 3.10.1944, H. Santapau 5039 (BLAT), 2.9.1949, H. Santapau 10267 (BLAT), Behran's plateau, 25.10.1950, H. Santapau 11688 (BLAT), 5.9.1951, H. Santapau 13345 (BLAT), 28.8.1954, H. Santapau 18983, 18984 (BLAT), 27.9.1954, C. Saldanha CS 1621, 1623, 1624 (BLAT), 7.9.1956, H. Santapau 21144 (BLAT), 8.9.1956, H. Santapau 21182 (BLAT), 9.9.1956, H. Santapau 20103,

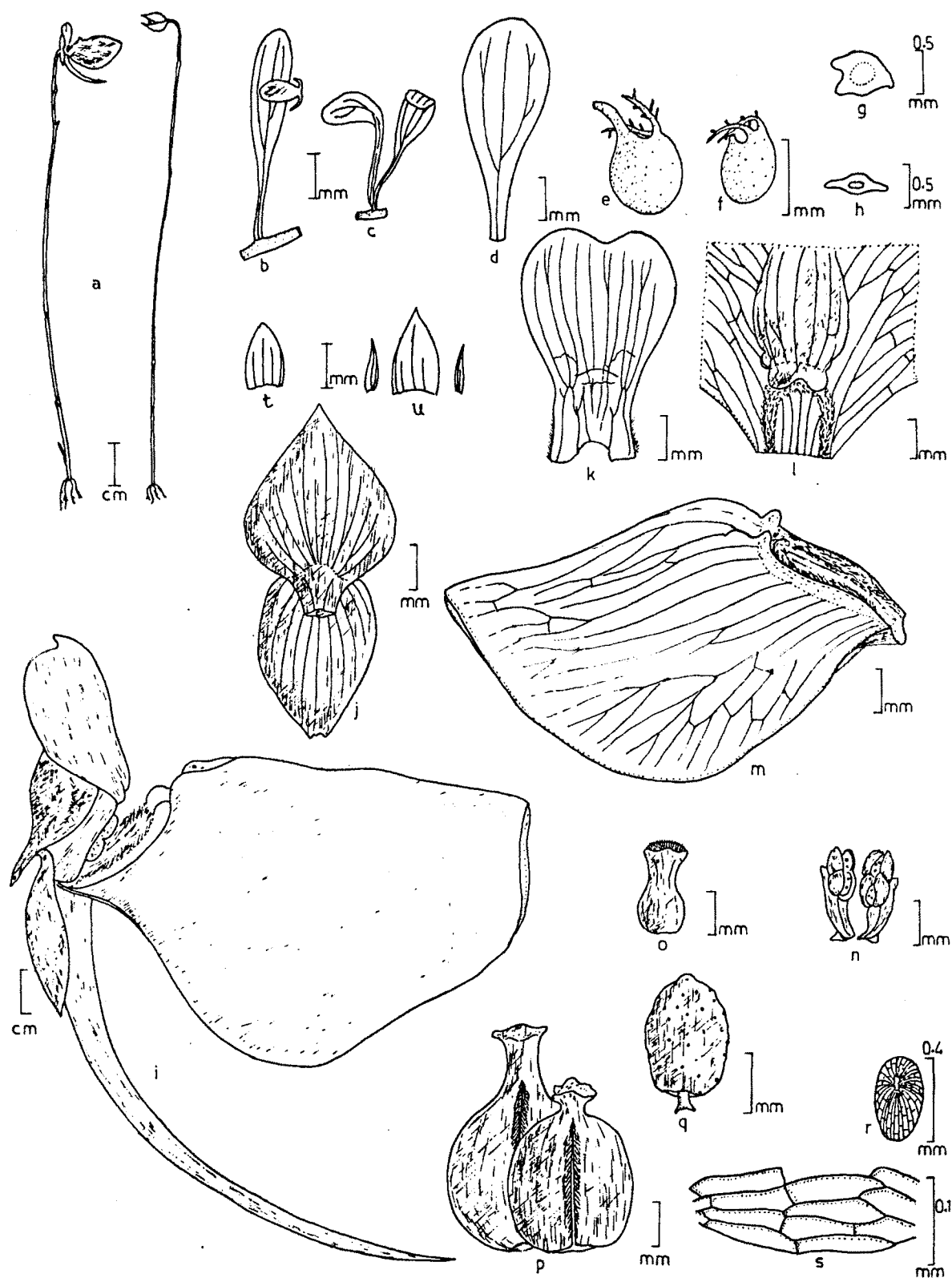


Fig. 27. *Utricularia purpurascens* Graham: a. Plants; b, c, d. Foliar organs; e, f. Traps; g. T.S. of scape; h. T. S. of pedicel; i. Flower; j. Calyx; k. Corolla - upper lip; l. Corolla - palate of lower lip; m. Corolla - lateral view of lower lip; n. Stamens; o. Pistil; p. Capsules; q. Placenta; r. Seed; s. Testa cells; t. scale; u. Bract & bracteoles.

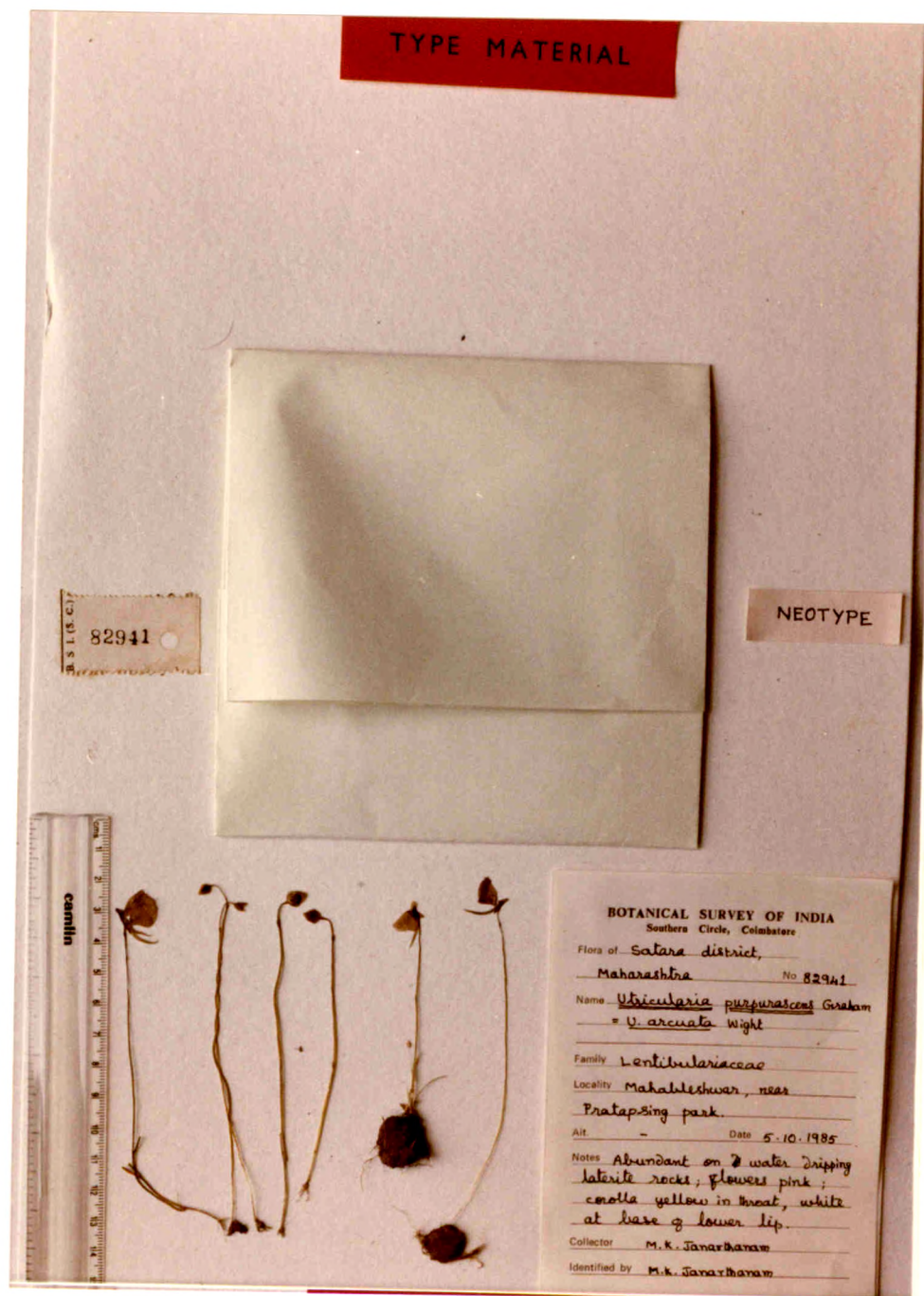


Photo 18. *Utricularia purpurascens* Graham (Neotype selected - MH).

21143 (BLAT); Satara dist., Mahabaleshwar, Venna lake, 9.10.1985, M.K. Janarthanam 82941, 82951, 82953 (MH), Old Mahabaleshwar Road, 6.10.1985, M.K. Janarthanam 82944 (MH); Pune dist., Ambavane Road, INS Shivaji, 12.10.1985, M.K. Janarthanam 82956 (MH).

26. *Utricularia recta* M.K. Janarthanam sp. nov.

Utricularia recta M.K. Janarthanam sp. nov. *U. scandens* Benj. affinis sed inflorescentiis erectis et calycibus lobis in fructiferum inaequalibus differt. - HOLOTYPE: INDIA. Meghalaya, Mawsmi near Cherrapunjee, 30.10.1986, M.K. Janarthanam 83032 (CAL). (Photo 19).

Utricularia wallichiana Wight var. *firmula* Oliver in J. Proc. Linn. Soc., Bot. 3: 182. 1859, non *U. firmula* Welw. ex Oliver, 1865; Clarke in Hook.f. Fl. Brit. India 4: 333. 1884. - TYPE: Khasia, 25.10.1850, J.D. Hooker & T. Thomson s.n.; Sikkim and Lachong, alt. 10-11,000 ped., J.D. Hooker (K, Photo !).

Utricularia scandens Benj. subsp. *scandens* var. *firmula* (Oliver) Subramanyam & Banerjee in Bull. Bot. Surv. India 10: 106. 1968; Subramanyam in Rec. Bot. Surv. India 20: 160. 1973; Taylor in Hara et al. Enum. Fl. Pl. Nepal 3: 132. 1982; Naithani, Fl. Chamoli 2: 478. 1985.

Herbs; rhizoids up to 1.5 cm long, thick, glandular, branches up to 3 mm long, papillose; stolons up to 8 cm long, sparsely branched. Foliar organs up to 5 cm long, linear, gland-dotted, 1-nerved, rounded or obtuse at apex.

Traps c 1 mm across, subglobose, slightly compressed; often a columnar appendage present on stalk; mouth basal; appendages 2, subulate, simple, glandular, gland-tipped. Racemes up to 20 cm long, erect, terete, each up to 10-flowered; scales 1-2 mm long, basifixed, lanceate to ovate-deltoid, 1-nerved, acute to acuminate at apex; bracts 1-2.5 mm long, basifixed, lanceate to ovate-deltoid, 1-nerved, acute to acuminate at apex; bracteoles shorter than bracts, subulate to linear, 1-nerved; flowers up to 15 mm long; pedicels 3-6 mm long, erect, winged. Calyx-lobes unequal; upper lobe c 3.2 x 2.7 mm (c 5 x 4 mm in fruit), broadly ovate, acuminate at apex, acuminate to caudate at apex in fruit; lower lobe c 3 x 1.5 mm (c 5 x 3 mm in fruit), oblong to oblanceate, or obovoid, bidentate at apex. Corolla yellow, purple streaked; upper lip up to 4 mm long, oblong, constricted at middle, crested across on ventral surface, ciliate at lower margin, obtuse at apex; lower lip up to 6 mm across, suborbicular to ovate, hairy in throat, gibbous at base, rounded to truncate at apex; spur up to 5 mm long, curved and acute at apex. Stamens c 1 mm long; filaments twisted; anther thecae distinct. Pistil c 1.2 mm long; ovary ovoid; style short; stigma 2-lipped. Capsules c 3 x 2.2 mm, ovoid, dehisce by a marginally thickened vertical slit; placenta c 2 mm long, ovoid. Seeds subglobose to obovoid; hilum terminal, prominent; testa reticulate, cells oblong. (Fig. 28; Photo 5 B).

Fl. & Fr.: August-November.

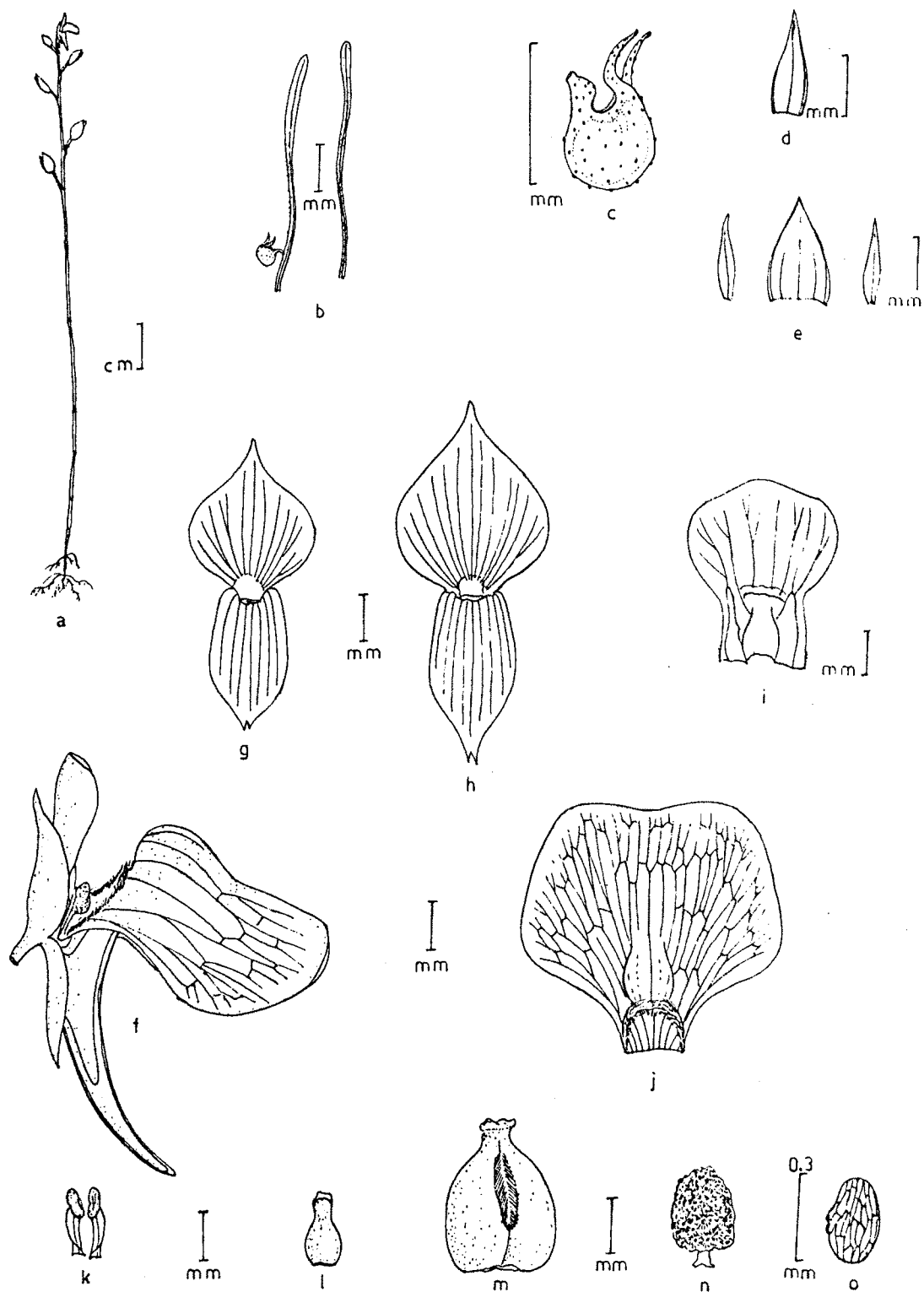


Fig. 28. *Utricularia recta* M.K. Janarthanam sp. nov.: a. Plant; b. Foliar organs; c. Trap; d. Scale; e. Bract & bracteoles; f. Flower; g. Calyx (in flower); h. Calyx (in fruit); i. Corolla - upper lip; j. Corolla - lower lip; k. Stamens; l. Pistil; m. Capsule; n. Placentum; o. Seed.

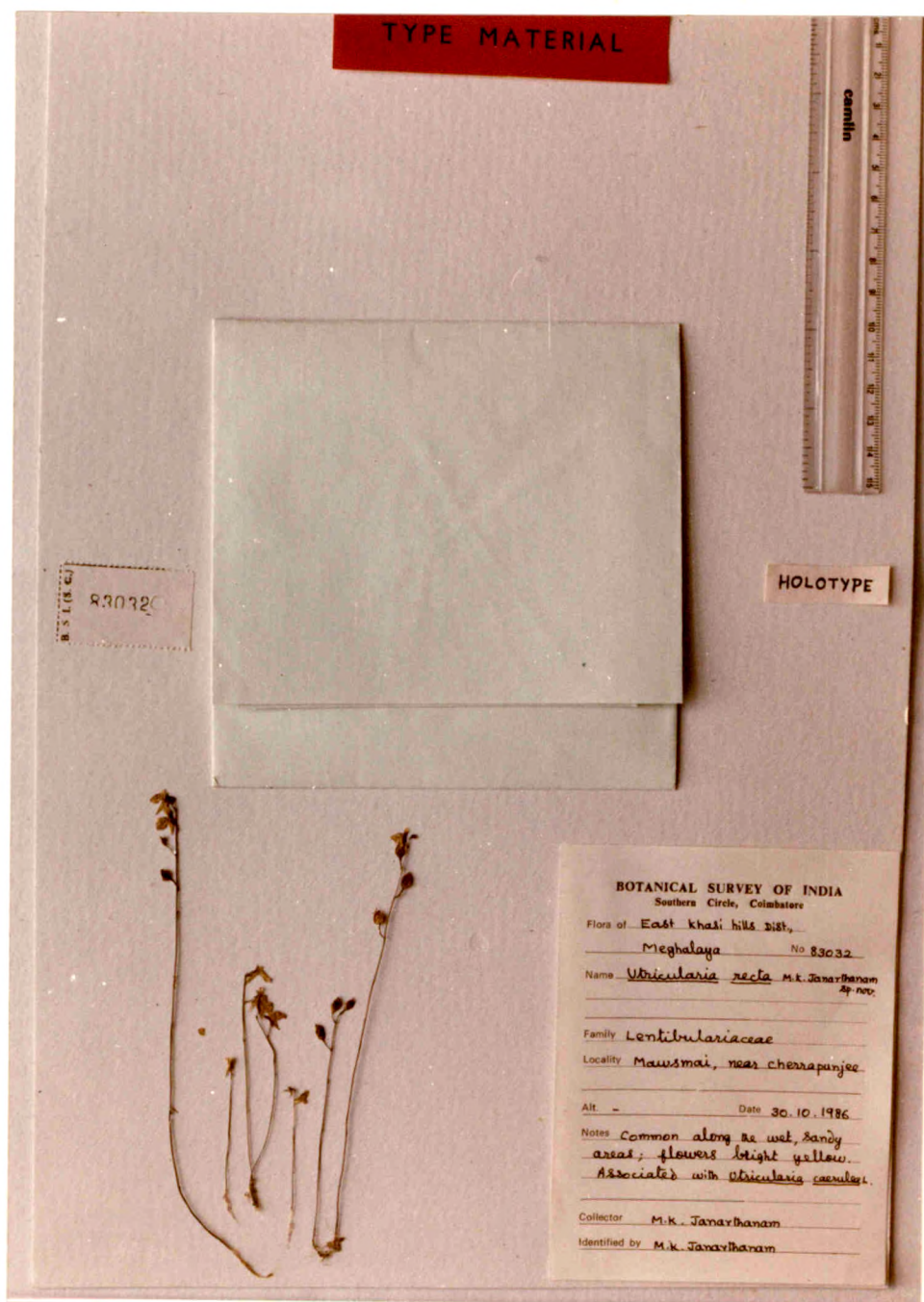


Photo 19. *Utricularia recta* M.K. Janarthanam sp. nov.
(Holotype -CAL).

Ecology: Terrestrial herb in wet or marshy places in open ground up to an elevation of 3,300 m.

Distribution: Endemic to Khasi hills and Himalayas: Bhutan, India, Northern Burma & Southwest China; in India recorded from Uttar Pradesh, Sikkim, Arunachal Pradesh, Assam and Meghalaya. (Map 7).

Notes: Utricularia recta is allied to U. scandens Benj. but differs in its erect inflorescence and unequal calyx-lobes in fruit. The specific epithet 'recta' is based on its erect inflorescence. Chromosome number published by Subramanyam & Kamble (1968) as U. scandens Benj. - $n = 7$, refers to this species.

Specimens examined:

ARUNACHAL PRADESH: Subansiri, 30.9.1959, G. Panigrahi 19848 (ASSAM); Kameng, Dun, 2000 m, 18.9.1964, J. Joseph 40083 (ASSAM).

ASSAM: s.l. & s.n. (CAL, Acc. no. 330235).

MEGHALAYA: Khasia, Shora, 4000 ft., 22.10.1871, C.B. Clarke 15570 (CAL), Shillong, 5000 ft., July 1890, H. Collett 40 (CAL); Mynkrem, 5.11.1938, G.K. Deka 18537 A (ASSAM); Pynursla, 6.9.1941, R.N. De & D.C. Forst s.n. (ASSAM); Shillong, 5000 ft., 2.10.1945, N.L. Bor 18440 (DD); Laityngkot, 6000 ft., 18.7.1946, F. Kingdonward 18 (CAL); Shillong, 7.9.1956, G.K. Deka s.n. (ASSAM, Acc. no. 21937); Cherrapunji-Mawmluh, K. & J. hills, 27.9.1956, G. Panigrahi 3517 (CAL); Jarain, 29.10.1956, G. Panigrahi 4195 (CAL); Dawki-Shillong Road, 1.10.1962, S.L. Kapoor &

party 75453 (LWG); Shillong, 4800 ft., 25.7.1963, Suman Chopra 78105 (LWG); Jowai, 6.9.1980, J. Joseph 76941 (ASSAM); Nongpoh, 10.10.1980, H. Deka 76949 (ASSAM), Barapani, BSI Experimental Garden, 29.10.1986, M.K. Janarthanam 83030 (MH), Cherrapunjee, Mawsmi, 30.10.1986, M.K. Janarthanam 83032 (CAL, MH).

SIKKIM: 1892, G.A. Gammie s.n. (CAL, DD); Choomthang, 19.9.1903, Prain s.n. (CAL); Lamteng, 20.9.1903, Prain s.n. (CAL); Lachung, Sept. 1903, F.E. Younghusband 1388 (DD); Cheungthang, 6.9.1915, G.H. Cave s.n. (CAL, Acc. no. 330232); Penlong La, 6500 ft., 3.7.1945, Bor's Collector 403 (DD); Gangtok, 5,500 ft., 7.9.1968, N.C. Majumdar 303 (CAL).

UTTAR PRADESH: Kumaun, Rishigange Valley, 3.10.1884, J.F. Duthie 3265 (CAL); Bininal, 5000 ft., 4.10.1884, J.F. Duthie 3265 (DD); Garhwal, Lobah, 5-6000 ft., 23.9.1885, J.F. Duthie 4267; W. Almora, Someswar, Kasi River, 26.8.1923, Champion s.n. (DD, Acc. no. 73095); Garhwal, Phata on way to Kedernath, 21.9.1958, M.A. Rau 6457 (BSD); Garhwal, Bagregad, 27.9.1963, U.C. Bhattacharya 30890 (BSD); Pithoragarh dist., Didihat Narayan Nagar, 1800 m, 30.9.1975, C.M. Arora & R. Prasad 56640 (BSD); Tehri dist., Buras Chava, 2000 m, 22.9.1979, A.K. Goel 67808 (BSD).

Tumloong, 10.7.1892, 5,500 ft., G.A. Gammie 258 (CAL).

27. *Utricularia reticulata* Smith, Exot. Bot. t. 119. 1805; Oliver in J. Proc. Linn. Soc., Bot. 3: 180. 1859,

excl. var. stricticaulis Koenig ex Oliver; Dalzell & Gibson, Bombay Fl. 135. 1861; Drury, Handb. Ind. Fl. 2: 122. 1866, excl. vars.; Clarke in Hook.f. Fl. Brit. India 4: 331. 1884 p.p.; Woodrow, J. Bombay Nat. Hist. Soc. 12: 176. 1898; Cooke, Fl. Bombay 2: 319. 1905 (2: 393. 1958 repr. ed.); Gamble, Fl. Madras 982. 1924 (2: 690. 1957 repr. ed.); Santapau in J. Bombay Nat. Hist. Soc. 49: 219. 1950 & in Rec. Bot. Surv. India 16: 188. 1967 (repr. ed.); Santapau & Janardhanan, Fl. Saurashtra 37. 1966; Shah, Fl. Gujarat 1: 515. 1978; Raghavan et al. in Rec. Bot. Surv. India 21: 63. 1981; Manilal & Sivarajan, Fl. Calicut 208. 1982; Sharma et al. Fl. Karnataka 196. 1984; Rao, Fl. Goa 2: 308. 1986; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 130. 1987. - TYPE: van Rheede, Hort. Malab. t. 70. 1689 & Smith, Exot. Bot. t. 119. 1805. Utricularia reticulata Smith var. parviflora Santapau in Kew Bull. 1948: 491. 1949; Santapau in J. Bombay Nat. Hist. Soc. 49: 220. 1950 & Fl. Khandala 188. 1967 (repr. ed.). - HOLOTYPE: Khandala, Behrans plateau, 31.10.1944, Santapau 5422 (BLAT!).

Utricularia caerulea auct. non L.; Burm.f. Fl. Ind. 11. 1768; Bhattacharyya in Bull. Bot. Soc. Bengal 30: 76. 1976 (1978) excl. var. graminifolia (Vahl) Bhattacharyya. Utricularia graminifolia sensu Graham, Cat. Pl. Bombay 165. 1839, non Vahl 1804.

Utricularia uliginosa sensu Wight, Ic. t. 1574 (right hand figure only). 1850, non Vahl 1804.

Herbs; rhizoids up to 2 cm long, capillary, branches 1-2 mm long, papillose; stolons up to 6 cm long, capillary, profusely branched, branches hyaline. Foliar organs up to 6 x 1 mm, linear, numerous on stolons, 1-nerved, glandular, attenuate at base, obtuse at apex. Traps 0.7-3 mm across, subglobose, slightly compressed, subdimorphic, those on leaves sessile or subsessile, and elsewhere stalked; stalk distally thickened; mouth basal; appendages 2, simple, subulate. Racemes up to 75 cm long, 1-2 mm thick, twining, rarely erect, glabrous, up to 12-flowered; scales 2-3 x 1-1.5 mm, basifixed, ovate to lanceate, 3-5-nerved, acute to acuminate at apex; bracts c 3 x 2 mm, basifixed, ovate to lanceate, 3-5-nerved, acute to acuminate at apex; bracteoles 2-3 x 0.3-0.5 mm, subulate, 1-nerved; flowers 15-25 mm long; pedicels 4.5-25 mm long, winged, erect in flower, spread or recurved in fruit. Calyx-lobes 4-8 x 3-7 mm (7-11 x 4.5-8 mm in fruit), lanceate to ovate, glandular within, acute to acuminate at apex in upper lobe, bi- or tridentate at apex in lower lobe. Corolla violet to pink; upper lip 7.5-12 mm long, obovate to sub-orbicular, broader than calyx-lobes, white-streaked, rounded, notched or slightly 3-lobed at apex; lower lip 10-15 x 8-11 mm, orbicular to obovate, hairy in throat, gibbous at base, truncate, notched or rarely rounded at apex; spur 6-10 mm long, conical, slightly curved, acute at apex. Stamens 2-3 mm long; filaments curved, strap-shaped, 1-nerved; anther thecae distinct. Pistil 2-3 mm long;

ovary ovoid, compressed; style short, distinct, flat; stigma 2-lipped, truncate at apex. Capsules 4-7 x 3.5-5.5mm, ovoid, oblongoid or discoid, compressed, dehisce by two marginally thickened vertical slits on both surfaces; placenta 3-4.5 x 3-3.5 mm, discoid to ovoid. Seeds 0.2-0.4 mm, obovoid, ellipsoid or rhomboid; hilum prominent, lateral; testa reticulate, cells elongate and finely striated within. (Fig. 29).

Fl. & Fr.: July-December (profuse); January-May (rare).

Local name: Malayalam - Kaka poo, Nelli poo.

Ecology: In wet or water-logged soil, especially in paddy fields; twining among themselves to form a rope or twining on paddy culms, sedges, Xyris sp. etc., from sea-level to 1000 m; sprouts up immediately after southwest monsoon.

Distribution: India and Sri Lanka; in India along the West coast from Saurashtra to Kerala through Maharashtra, Goa, Karnataka and areas of Tamil Nadu bordering Kerala. (Map 8).

Pollen: Isopolar, tetracolporate or pentacolporate, 4-5-lobed in polar view, elliptic in equatorial view; 23-25 x 31-32 μ (Thanikaimoni 1966).

Notes: Inflorescence of Utricularia reticulata Smith is the largest of all the species of Utricularia occurring in India. This was perhaps one of earliest plants reported

from India as 'Nelipu' by van Rhee in his Hortus Malabaricus (1689). This Malayalam name was based on 'Nellu' = paddy; Pu = flower, since the plants occur mostly in paddy fields. This was included in U. caerulea L. by Linnaeus (1753), until Smith (1805) rightly segregated and named it as U. reticulata.

Type collection of U. reticulata Smith var. parviflora Santapau was critically studied. This represented only the stunted form of the species. Since intermediates are seen this variety is not recognised in the present work.

Specimens examined:

GOA: Panjim-Margoa, Santacruz, 8.11.1962, R.S. Rao 84421 (BSI, CAL); Vernem-Pelernem, 19.11.1962, R. Seshagiri Rao 84947 (BSI, CAL); Valpoi, Nandore, 3.5.1963, K.C. Kanodia 88375 (BSI); Ballai Verna Plateau, 21.8.1963, K.C. Kanodia 89429 (BSI, CAL); Vernem, 13.9.1965, John Cherian 106125 (BSI, CAL); Angidev, 24.9.1965, John Cherian 106663 (BSI, CAL).

KARNATAKA: N. Canara, Yellapore, 1881, W.A. Talbot 142 (CAL), 1882, W.A. Talbot s.n. (BSI, Acc. no. 6957), date 1883, W.A. Talbot s.n. (BSI, Acc. no. 6965), Sept. 1884, W.A. Talbot s.n. (BSI, Acc. no. 6964), 10.1.1894, W.A. Talbot 3230 (BSI, DD); S. Kanara, Jahlsur, 22.11.1900, C.A. Barber 2529 (CAL), Beltangadi, 25.11.1900, C.A. Barber 2529 (MH); Mysore, Talaguppa, 2-3,000 ft., Oct. 1908, A. Meebold 9800 (CAL); S. Kanara, Karkal, 17.3.1915, s.l.

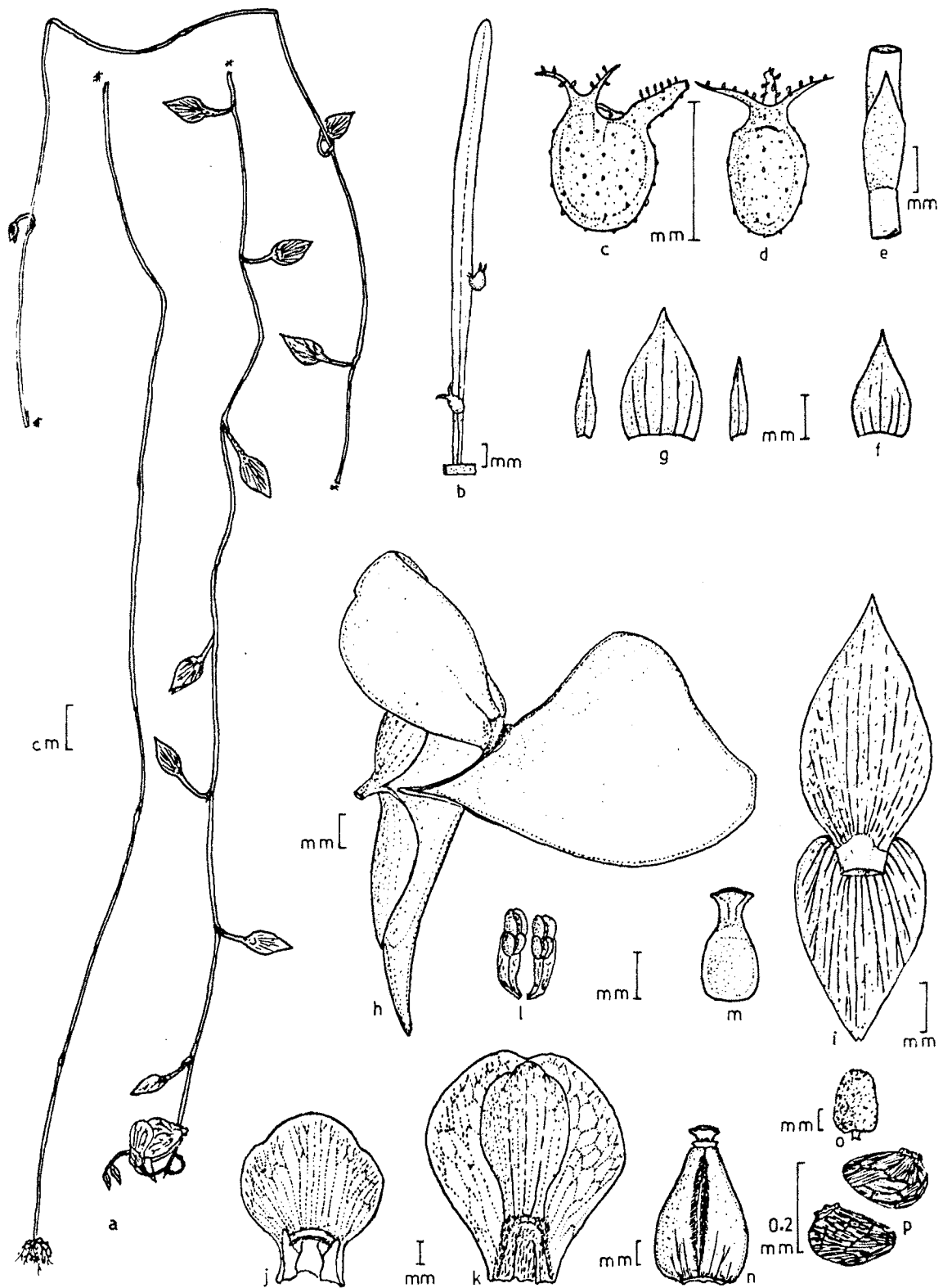
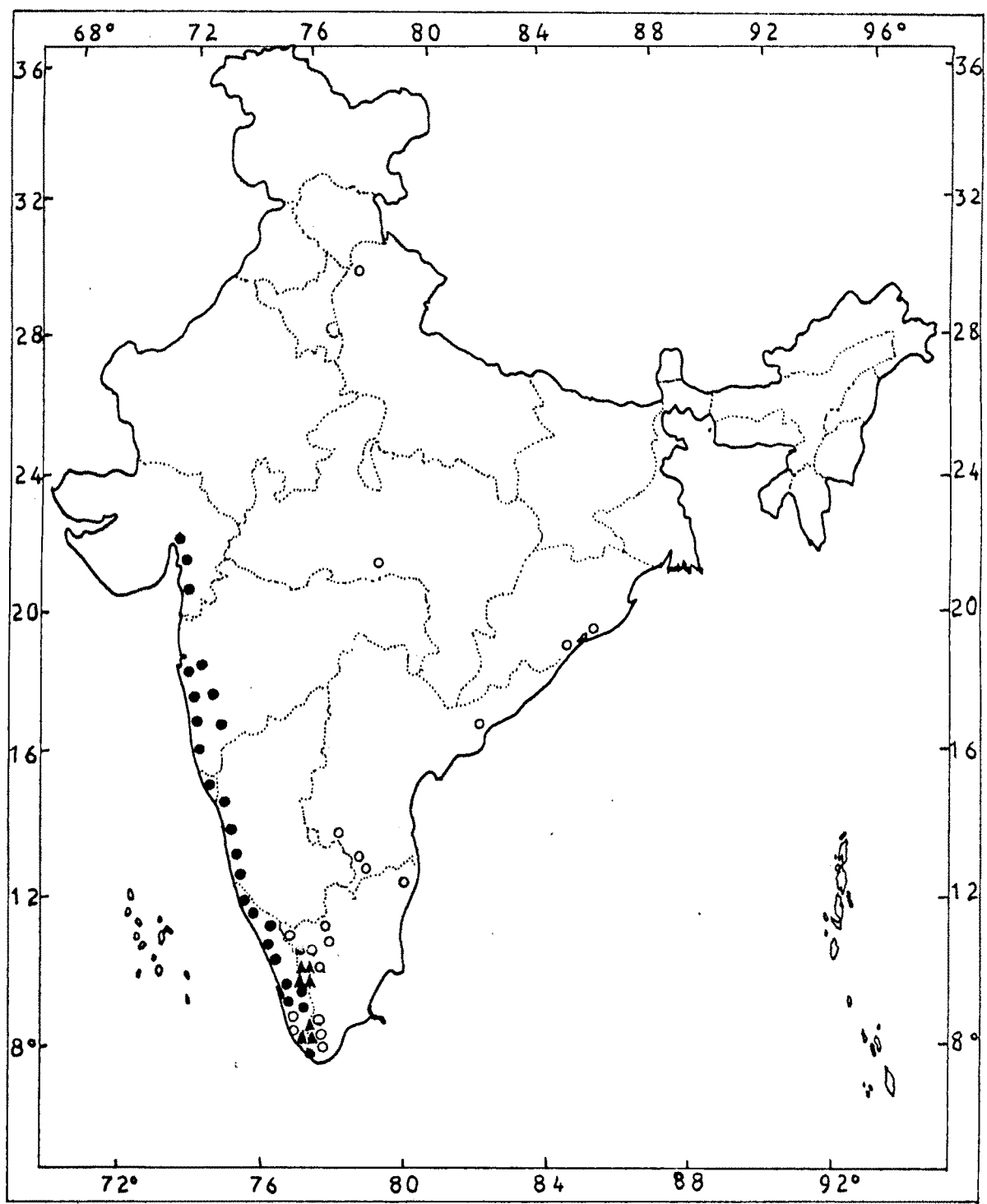


Fig. 29. *Utricularia reticulata* Smith: a. Plant; b. Foliar organ; c. Trap - lateral view; d. Trap - front view; e. Scale on scape; f. Scale; g. Bract & brecteoles; h. Flower; i. Calyx; j. Corolla - upper lip; k. Corolla - lower lip; l. Stamens; m. Pistil; n. Capsule; o. Placentum; p. Seeds.



Map 8. Distribution: ● *Utricularia reticulata* Smith
▲ *U. roseopurpurea* Stapf ex Gamble
○ *U. scandens* Benj.

11974 (MH), Wandse, 10.3.1916, s.l. 12818 (MH); N. Kanara, Anmod, 25.12.1917, Sedgwick 3271 (CAL, PCM); Karwar, Dec. 1918, L.J. Sedgwick 5034 (BLAT); Karwar, Oct. 1919, Hall & McCann 34261, 34262 (BLAT); S. Kanara, Karkal, 250 ft., 23.11.1920, C.E.C. Fischer 4560 (CAL); Mysore, Anantapur, 23.9.1928, N.F. Fyson 6506 (PCM), Ashiearibettu, 12.10.1958, P.B. Kamath 341 (PCM), Agumbe, 28.10.1960, R. Sundararaghavan 67827 (BSI), 4.11.1960, R. Sundararaghavan 68170 (BSI); Shimoga, Karodi, Tirthahalli, 28.9.1962, R. Sundararaghavan 82753 (BSI); Yedur-Kavaledurga, 11.2. 1963, R. Sundararaghavan 86018 (BSI), Agumbe, Kundadagudde, 19.8.1963, R.S. Raghavan 90004 (BSI); S. Kanara, Suratkal, 29.7.1978, Cecil J. Saldanha, S.R. Ramesh & N.S. Ravindra KFP 1993 (CAL); Kodagu dist., Makut, 10.10.1978, S.R. Ramesh & P. Prakash KFP 3158 (CAL); S. Kanara, Mangalore, Kulshekar, 19.8.1985, M.K. Janarthanam 82915 (MH).

KERALA: Cochin, April 1848, R. Wight s.n. (CAL, Acc. no. 330140); Malabar, 1865, R.H. Beddome s.n. (MH, Acc. no. 36580), Stocks & Law s.n. (MH, Acc. no. 36582), Tellicherry, Oct. 1883, Lawson s.n. (MH Acc. no. 36579); Cochin, Sept. 1884, Gamble 14705 (CAL), 1884, M.A. Lawson s.n. (MH, Acc. no. 36578); Quilon 4.8.1887, Lawson s.n. (MH, Acc. no. 36650); Trivandrum, Kudinangulam to Anjithenga, 4.11.1904, C.A. Barber 6772 (MH); Tellicherry, Kuthuparamba, 22.9.1913, s.l. 9340 (MH); Quilon, 24.4.1913, M. Rama Rao 1060 (DD); Quilon, 1.10.1913, M. Rama Rao 2205 (CAL); Cannanore dist., Ettabode, 2.10.1961, C. Saldanha

CS 7245 (BLAT); Villumalai area, 14.2.1961, K.N. Subramanian 70691 (BSI), 16.2.1961, K.N. Subramanian 70793 (BSI); Olavakkot, 5.2.1964, J. Joseph 17595 (MH); Trichur, Chalakudi, 8.12.1965, K.M. Sebastine 26667 (MH); Trivandrum, Kottur R.F., 29.9.1973, J. Joseph 44463 (MH); Trichur-Chalakudi, 15.9.1976, K. Ramamurthy 48532 (CAL, MH); Telli-cherry, Kuthuparamba Road, 18.11.1977, V.S. Ramachandran 52197 (MH), Kuthuparamba 20.2.1978, V.S. Ramachandran 54103 (CAL, MH); Pathanamthitta, Ranni, 27.7.1978, C.N. Mohanan 58339 (MH); Trivandrum dist., Agastyar peak, Kaviar, 18.3.1978, M. Mohanan 54705 (CAL, MH), Cannanore, Kannothe, 25.2.1979, V.S. Ramachandran 61906 (CAL, MH), Pappinisseri, 4.10.1979, R. Ansari 64717 (CAL, MH), Mambram 14.12.1979, V.S. Ramachandran 65204 (CAL, MH); Cannanore dist., Kannothe R.F., 18.2.1978, V.S. Ramachandran 54038 (CAL, MH), Telli-cherry, 24.8.1985, M.K. Janarthanam 82931 (MH); Calicut dist., Iringal, 25.8.1985, M.K. Janarthanam 82935 (MH); Palghat dist., Malampuzha, 15.9.1985, M.K. Janarthanam 82938 (MH).

MAHARASHTRA: Herb. Dalzell s.n. (CAL, DD); Jambgaon, Dec. 1890, Gangaram s.n. (BSI); Pune, Lonavla, 12.11.1904, L.D. Garade s.n. (BSI); Khandala hill top, 2500 ft., Oct. 1921, L.J. Sedgwick 7936 (BLAT), Tigers leap plateau, Oct. 1918, s.l. 27562-27566 (BLAT); Ratnagiri dist., Khed, Sept. 1922, R.D. Acland 859, 860 (BLAT), Panwell, Sept. 1925, R.B. Acland ACK 858 (BLAT); Karjat, 11.12.1948, H. Santapau 9641 (BLAT); Bombay, Ankola, 4.9.1949, J.C.

Dhrume 29 (CAL); Khandala, Kune Plateau, 5.9.1951, H. Santapau 13346 (BLAT); Panwell, 8.11.1953, K.V. Shenoy KVS 1256, KVS 1264 (BLAT); Malad, Marve Road, 24.12.1955, G.L. Shah 6612, 6613 (BLAT), 2.11.1957, G.L. Shah 9390 (BLAT); Ratnagiri dist., Janavle, 25.11.1961, M.Y. Ansari 78461 (BSI), Mangaon-Akeri, 12.11.1965, B.G. Kulkarni 106430 (BSI), Kadawal, Kudal, 18.11.1965, B.G. Kulkarni 107610 (BSI), Sanantawadi, Kudal, 26.10.1969, B.G. Kulkarni 119042 (BSI), Devichi Rai, Phonda, 3.10.1970, B.G. Kulkarni 121379 (BSI); Pune dist., INS Sivaji, Ambavane Road, 12.10.1985, M.K. Janarthanam 82958 (MH).

TAMIL NADU: Coimbatore dist., Walayar, 1.1.1958, K. Subramanyam 5410 (CAL, MH).

Without locality, Wight 2414 (CAL, MH).

28. *Utricularia roseopurpurea* Stapf ex Gamble, Fl. Madras 983. 1924 (2: 691. 1957 repr. ed.); Fyson, Fl. S. Ind. Hill. St. 1: 438. 1932; Subramanyam & Banerjee in Bull. Bot. Surv. India 10: 103. 1968; Sharma et al. Fl. Karnataka 196. 1984; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 131. 1987. - LECTOTYPE: Anamalais, Paralai, 7 Nov. 1901, C.A. Barber 3982 (MH!, Acc. no. 36624) (Janarthanam & Henry ined.). (Photo 20).

Utricularia rosea auct. non Edgew. 1848; Oliver in J. Proc. Linn. Soc., Bot. 3: 184. 1859; Drury, Handb. Ind. Fl. 2: 125. 1866; Clarke in Hook.f. Fl. Brit. India 4: 333. 1884.

Utricularia racemosa sensu Wight, Ic. t. 1584. f. 1. 1850,
non Wall. ex Walp. 1843.

Herbs; rhizoids up to 2 cm long, filiform, simple or rarely branched, glandular; stolons up to 2 cm long, filiform, branches opposed to foliar organs. Foliar organs up to 15 x 3 mm, spatulate to obovate, 1-nerved, rounded at apex, rosulate at scape base and on stolons. Traps 1-2 mm across, globose to ovoid; mouth terminal; lip extended to a beak-shaped structure and rim around mouth, glandular hairy along edges of beak and rim. Racemes up to 25 cm long, erect, glabrous, 1-7-flowered; scales 1.5-4 mm long, medifixed, elliptic, acute or rarely bifid at base and apex; bracts 2-3 mm long, medifixed, elliptic, 1-nerved, acute at base and apex; bracteoles 1.5-2 mm long, medifixed, limbs unequal; flowers 7-11 mm long; pedicels 1-2 mm long, erect, terete, papillose, often recurved in fruit. Calyx-lobes unequal, hooded, papillose; upper lobe 2.5-3 x 2-2.5 mm, broadly ovate, obtuse at apex; lower lobe 2-2.5 x 1.5-2 mm, obovate, obtuse or slightly retuse at apex. Corolla pink; upper lip c 5 mm long, linear, constricted at middle, hairy at lower margin, truncate or retuse at apex; lower lip c 7.5 x 7 mm, suborbicular, gibbous at base, crested, rounded or retuse at apex; spur c 3.5 mm long, shorter than lower lip, obtuse at apex. Stamens c 1.5 mm long; filaments strap-shaped, curved; anther thecae distinct. Pistil 1.5-2 mm long; ovary more or less rectangular in outline,

compressed; style as broad as ovary, papillose; stigma 2-lipped, lower semiorbicular, upper subulate or obsolete. Capsules 2-3 mm across, globose to subglobose, papillose, attached to upper calyx-lobe, dehisce vertically on one side or 2-valved; placenta c 1.5 mm long, globose to ovoid, pitted. Seeds c 0.2 mm long, obovoid, papillose to tuberculate; hilum prominent, subterminal; testa reticulate, cells elongate. (Fig. 30); (Photo 6D).

Fl. & Fr.: September-January (-May).

Ecology: On dripping rocks from 850 to 2,500 m.

Distribution: India and Sri Lanka in higher altitudes; in India distributed in Western Ghats of Tamil Nadu, Kerala and (?) Karnataka. (Map 8).

Pollen: Isopolar, tricolporate; 3-lobed in polar view, elliptic in equatorial view (Thanikaimoni 1966).

Notes: Edgeworth (in Proc. Linn. Soc. London 1: 352. 1848) described Utricularia rosea Edgew. based on the specimens collected from Burdwan in West Bengal. Subsequent workers like Oliver (l.c.) and Clarke (l.c.) while treating U. rosea, doubtfully included some collections from Southern India and Sri Lanka. These specimens were correctly accommodated in a new species - U. roseopurpurea Stapf in Herb. Kew. The name U. roseopurpurea Stapf remained in mss. until Gamble (l.c.) validated it.

Gamble (l.c.) did not designate any types, though he had critically studied and determined several collections from "W. Ghats, Anamalais, Pulneys and hills of Travancore,

to 7,000 ft., in Swamps" which are present in CAL, K and MH. After studying the original materials, the collection C.A. Barber 3982 (Paralai, Anamalais, 7 November 1901 (MH, Acc. no. 36624) is selected as the Lectotype of the species.

Taylor (1977) treats U. roseopurpurea Stapf ex Gamble and U. caerulea L. conspecific. They can however be clearly differentiated as follows:

<u>U. caerulea</u> L.	<u>U. roseopurpurea</u> Stapf ex Gamble
1. Upper lip of corolla with 2 horn like projections on ventral surface	Upper lip of corolla without any projections.
2. Lower lip of corolla less than 5 mm long	Lower lip of corolla more than 7 mm long.
3. Spur much longer than lower lip, curved up- wards, acute	Spur shorter than lower lip, straight, obtuse.
4. Seeds reticulate, smooth	Seeds reticulate, papillose or tuberculate.

Specimens examined:

KERALA: Travancore, Devicolam, 7000 ft., Dec. 1909, A. Meebold 13517 (CAL); Idukki dist., (Kottayam dist.) Munnar, 5.11.1961, C. Saldanha C.S. 8045 (BLAT), Lockhart gap-Devicolam, 12.10.1963, K.M. Sebastine 17542 (CAL, MH), Umaiyamalai grassy slopes, 17.11.1965, B.V. Shetty 26486 (CAL, MH); Trivandrum dist., Western slopes of Agastyamalai, 6.10.1973, J. Joseph 44629 (MH); Idukki dist., Lockhart gap, 13.12.1985, M.K. Janarthanam 82964 (MH).

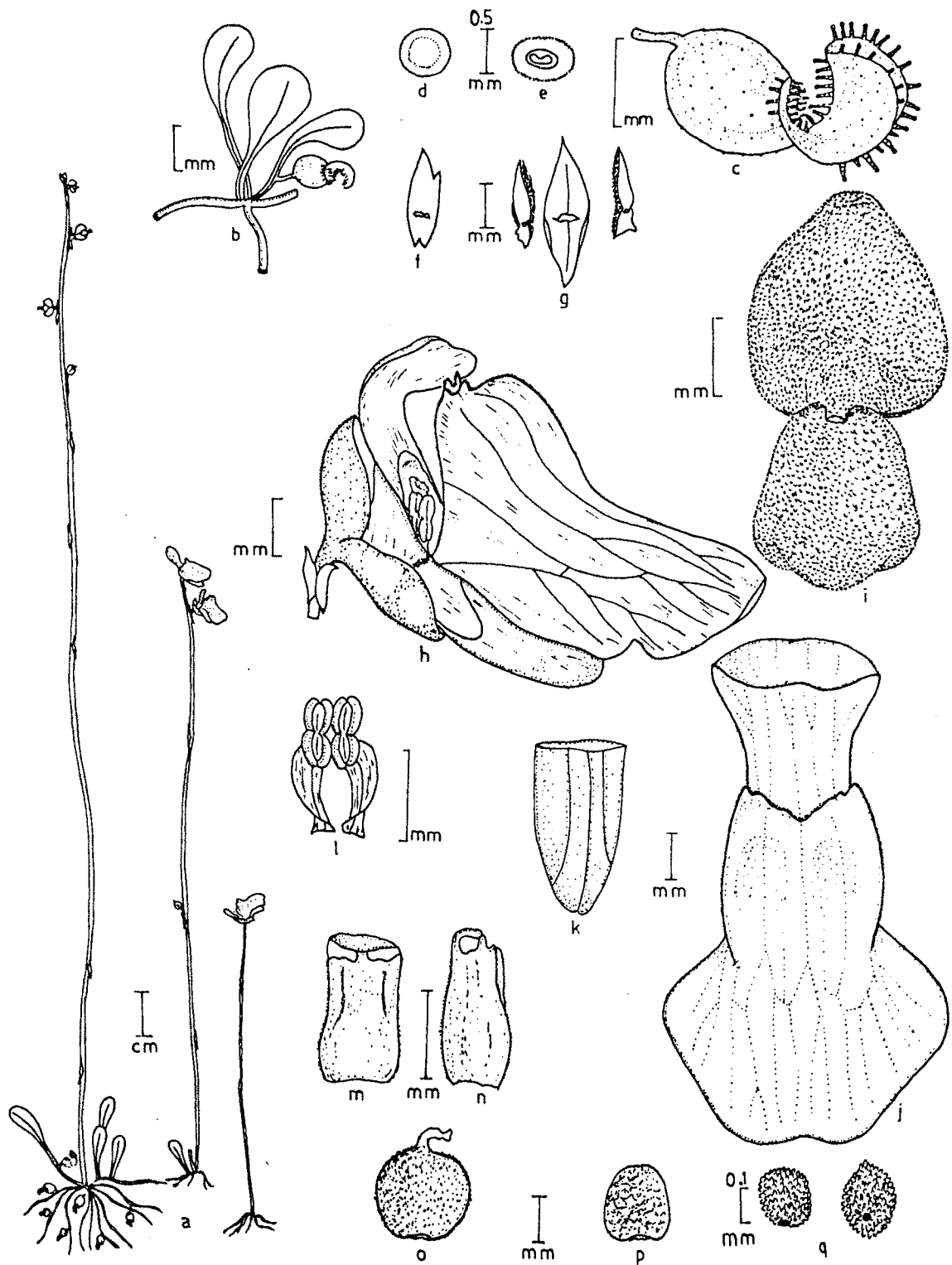


Fig. 30. *Utricularia roseopurpurea* Stapf ex Gamble: a. Plants; b. Foliar organs; c. Trap; d. T.S. of scape; e. T.S. of pedicel; f. Scale; g. Bract & bracteoles; h. Flower; i. Calyx; j. Corolla; k. Spur; l. Stamens; m. Pistil - adaxial view; n. Pistil - lateral view; o. Capsule; p. Placenta; q. Seeds.



Photo 20. *Utricularia roseopurpurea* Stapf ex Gamble
(Lectotype selected - MH).

TAMIL NADU: Tirunelveli dist., Agastiarmalai, 22.5.1901, C.A. Barber 2936 (MH); Coimbatore dist., Anamalais, Poonachi, 10.10.1901, C.A. Barber 3716 (MH); Paralai, 7.11.1901, C.A. Barber 3982 (MH), Grass hills above Iyerpadi, 10.11.1901, C.A. Barber 4025 (MH), Around Attakatti, 25.1.1962, J. Joseph 13552 (CAL), 13565 (MH, only Acc. no. 27419); Kanniyakumari dist., Grassy slopes - way to Mahendragiri, beyond Sengamal estate, 5.12.1969, B.V. Shetty 33050 (CAL, MH), Muthukuzhivayal, 29.9.1980, A.N. Henry 68866 (CAL, MH).

29. *Utricularia scandens* Benj. in *Linnaea* 20: 309. 1847; Taylor in *Kew Bull.* 18: 46. 1964 & in *Steenis Fl. Males.* I. 8: 283. 1977; Abraham & Subramanyam in *Proc. Indian Acad. Sci.* 62 B: 98. 1965; Ramasamy & Razi, *Fl. Bangalore* 548. 1973; Gandhi in *Saldanha & Nicolson, Fl. Hassan* 565. 1976; Raizada, *Suppl. Fl. Gangetic Plains* 195. 1976; Basak in *Bull. Bot. Surv. India* 17: 104. 1975 (1978); Raizada & Saxena, *Fl. Mussoorie* 1: 524. 1978; Balakrishnan, *Fl. Jowai* 2: 343. 1983; Srivastava in *J. Econ. Tax. Bot.* 4: 190. 1983; Rani & Matthew in *Matthew, Fl. Tamilnadu Carnatic* 3: 1120. 1983; Sharma et al. *Fl. Karnataka* 196. 1984; Mukerjee, *Fl. Pachmarhi Bori Res.* 217. 1984; Chandrasekaran in *Henry et al. Fl. Tamil Nadu I.* 2: 131. 1987. - HOLOTYPE: Madras, Arcot, Chuter s.n. (K, Photo !).

Utricularia volubilis Wight ex Benj. in *Linnaea* 20: 309. 1847, pro syn., non R. Br. 1810.

Utricularia wallichii Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849.

Utricularia wallichiana Wight, Ic. t. 1572. f. 1. 1850, non Benj. 1845; Oliver in J. Proc. Linn. Soc., Bot. 3: 182. 1859, excl. var. firma Oliver; Drury, Handb. Ind. Fl. 2: 124. 1866; Clarke in Hook. f. Fl. Brit. India 4: 332. 1884, excl. var. firma Oliver; Prain, Bengal Pl. 2: 781. 1903 (2: 582. 1963 repr. ed.) & in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74: 371. 1905; Fyson, Fl. Nilgiri & Pulney Hill tops 1: 307. 1915 & 2: t. 204. 1915 & Fl. S. Ind. Hill St. 437. 1932 & 2: t. 378. f. 2. 1932; Haines, Bot. Bihar Orissa 3 & 4: 646. 1922 (2: 677. 1961 repr. ed.); Gamble, Fl. Madras 982. 1924 (2: 690. 1957 repr. ed.); Barnes, Suppl. Fl. Pl. Madras 28. 1938; Mooney, Suppl. Bot. Bihar Orissa 102. 1950; Oommachan, Fl. Bhopal 283. 1977. - TYPE: INDIA. Courtallam, 1837, Wight 2709; Nilgiri, June 1849, Wight 4; Sirra mullay, Oct. 1837, Wight s.n. (K, Photo !).

Utricularia macrolepis Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 373. 1849 & Ic. t. 1580 f. 2. (excl. seeds). 1850. -TYPE: INDIA. Courtallam, 1837, Wight 2709-b (K, Photo!).

Utricularia wallichiana Wight var. macrolepis (Wight) Gamble, Fl. Madras 982. 1924 (2: 690. 1957 repr. ed.).

Herbs; rhizoids up to 1.5 cm long, branches up to 1 mm, papillose; stolons up to 3 cm long, filiform, profusely branched. Foliar organs up to 15 x 1 mm, linear, 1-nerved, acute or rounded at apex. Traps c 1 mm across,

more or less globose; stalk glandular, often columnar growth present near base; mouth basal; appendages 2, simple, subulate. Racemes up to 25 cm long, twining, rarely erect in smaller ones, glabrous, 1-9-flowered with sterile bracts present in between fertile ones; scales 0.7-1.5 mm long, basifixed, ovate to lanceate, acute to acuminate at apex, 1-nerved, rarely nerves absent; bracts 1-1.5 mm long, basifixed, broadly ovate, 1-nerved, acuminate to caudate at apex; bracteoles 0.3-1.4 mm long, linear to lanceate, 1-nerved, rarely nerves absent; flowers 5-12 mm long; pedicels 1-5 mm long, erect, winged. Calyx-lobes 2-3 x 1.1-3 mm (3-5 x 2-4 mm in fruit), ovate; upper lobe acute to acuminate at apex; lower lobe bi- or tridentate at apex. Corolla yellow; upper lip 2-3 mm long, obovate to oblong, constricted near middle, a crest running across at middle, obtuse to emarginate at apex; lower lip 3-6.5 x 2.5-3 mm, more or less obovate, hairy in throat, gibbous at base, rounded or shallowly emarginate at apex; spur 2-6 mm long, subulate or rarely conical, acute and curved at apex. Stamens c 1 mm long; filaments flat, twisted; anther thecae distinct. Pistil c 1 mm long; ovary ovoid; stigma bilipped, lower lip oblong and hairy, upper lip semiorbicular and glabrous. Capsules c 2.5 x 1.5 mm, oblongoid to ovoid, dorsiventrally compressed, dehiscent margin thickened; placenta c 1.5 x 1 mm, compressed, oblong, shallowly pitted. Seeds 0.2-0.35 mm long, ovoid to ellipsoid; hilum prominent; testa reticulate, cells elongated. (Fig. 31).

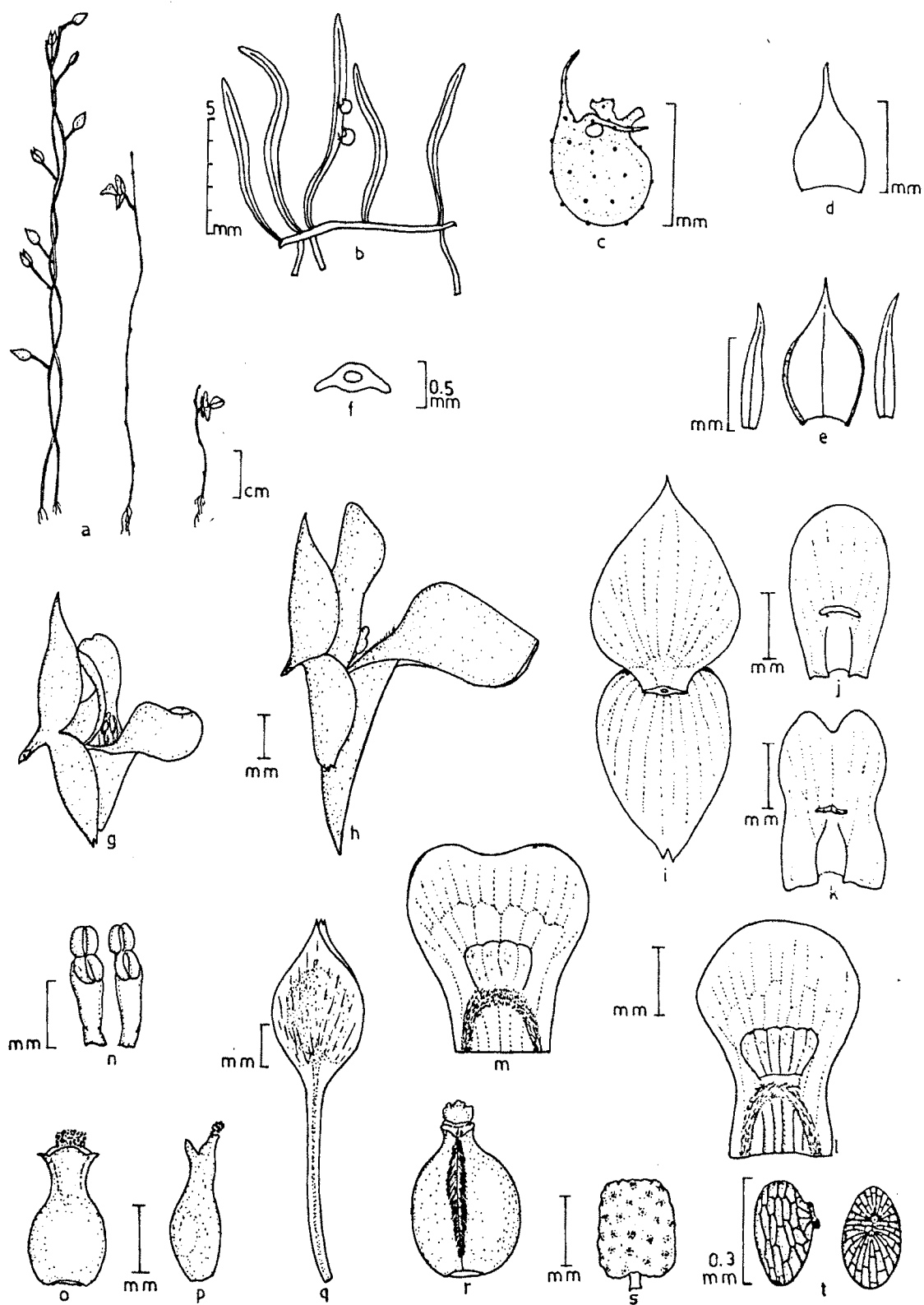


Fig. 31. *Utricularia scandens* Benj.: a. Plants; b. Foliar organs; c. Trap; d. Scale; e. Bract & bracteoles; f. Pedicel; g, h. Flowers; i. Calyx; j, k. Corolla - upper lip; l, m. Corolla - lower lip; n. Stamens; o. Pistil - adaxial view; p. Pistil - lateral view; q. Fruit; r. Capsule; s. Placenta; t. Seeds.

Fl. & Fr.: Throughout the year with a peak during September to December.

Ecology: Along wet and marshy places, twining among themselves or on other plants; from sea-level to 2,600 m.

Distribution: Africa to Northern Australia through India and Malesia; in India distributed in Uttar Pradesh, Bihar, W. Bengal, Meghalaya, Orissa, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka and Kerala. (Map 8).

Chromosomes : $n = 6, 7 (?)$ (Subramanyam & Kamble, 1968).

Pollen: Isopolar, tricolporate or tetracolporate, 3-4-lobed in polar view, elliptic in equatorial view; $22-23 \times 28-30 \mu$ (Thanikaimoni 1966).

Notes: Utricularia scandens Benj. is easily recognised in the field by its combination of characters like twining racemes, yellow flowers and presence of sterile bracts in between fertile ones.

Due to its thick, erect inflorescence and highly unequal fruiting calyx-lobes var. firmula has been raised to a status of species in this work.

Specimens examined:

ANDHRA PRADESH: Chittoor dist., Chamalavalley, 1000 ft., 23.3.1918, C.E.C. Fischer 4296 (CAL), Madanapalli, 2500 ft., 27.12.1921, C.E.C. Fischer 4711 (CAL), Visakhapatnam dist., Anjoda-Gengi Gedda, 12.3.1965, G.V. Subba Rao 22606 (MH); Chittoor dist., Puttur-Kailasakona, 26.6.1969, G.V. Subba Rao 32025 (MH); Anantapur dist.,

Garugudukona, 21.12.1982, T. Pullaiah 953 (MH).

KARNATAKA: Mysore, Aglatti, 3,500 ft., Nov. 1908, A. Meebold 10328 (CAL), Agumbe, Vanake abbi falls, 3.11.1960, R. Sundararaghavan 68102 (BSI).

KERALA: Ariankavu, Pandyan para hill top, 2.12.1961, K.N. Subramanian 77380 (BSI); Trivandrum dist., Forest near Bonnaccord Estate, 9.10.1973, J. Joseph 44645 (MH).

MADHYA PRADESH: Pachmarhi, Wet ground near the Bee falls, 18.2.1891, J.F. Duthie 10493 (CAL, DD).

ORISSA: Baliguda to Kotagarh 10th mile, 7.3.1964, S.L. Kapoor & party 64584 (LWG).

TAMIL NADU: Nilgiri, Coonoor, 5000 ft., April 1883, J.S. Gamble 11356 (CAL), Coonoor, 6000 ft., Sept. 1883, J.S. Gamble 12718 (CAL, DD), Pulneys, Kodaikanal dist., 1897, A.G. Bourne s.n. (CAL, Acc. no. 330219), Kodaikanal falls, 9.3.1898, A.G. Bourne 304 (MH, PCM); Pykara, 28.12.1900, C.A. Barber 2680 (CAL, MH); Coimbatore, Anamalai, Poonachi, 10.10.1901, C.A. Barber 3732 (MH); Coimbatore, Singampatti, Bolampatti valley, 1700 ft., 28.9.1910, C.E.C. Fischer 2247 (CAL), Varadimalai, Bolampatti hills, 10.5.1911, C.E.C. Fischer 2726 (CAL); Dharmapuri dist., Hosur, 30.12.1916, s.l. 13973 (MH); Madurai dist., Highwavy mountains, May 1917, Bl. & Hall. 495 (BLAT); Yercaud, January 1931, Fyson 6986 (PCM); Sirumalais, 14.5.1958, J. Pallithanam JP 3291 (BLAT); Yercaud, Kakasholai-Balmadies Estate, 14.9.1958, K. Subramanyam 6595 (MH); Tirunelveli, Forest surrounding Agasthiyar falls, Lower Camp, 15.11.1959,

K.M. Sebastine 9686 (MH); Coimbatore, Anamalais, (MH, Acc. no. 36656); Poonachi, 24.1.1962, J. Joseph 13581 (MH), slope of Ethuwarai, 21.11.1962, C.P. Sreemadhavan CPS 311 (MH); Shevaroyis, 5.10.1964, A.V.N. Rao 18266 (CAL, MH); Perumalmalai (Kodaikanal), 25.4.1965, K. Ramamurthy 23445 (MH); Yercaud, Between mines and Balamadies Estate, 5.11.1965, A.V.N. Rao 26953 (MH), Kaveri peak, 4.11.1968, D.B. Deb 31294 (CAL, MH), Kongampallam, 15.2.1969, D.B. Deb 31426 (CAL, MH); Kanniyakumari dist., Panagudi, Kandakki Estate, 3.12.1969, B.V. Shetty 33014 (MH); Coimbatore dist., Perumalmudi, 21.4.1970, M.V. Viswanathan MVV 556 (MH); Nilgiri dist., Aravankadu, 5.9.1970, B.D. Sharma 36043 (MH), Ebanad, Slopes of Koil Betta, 10.9.1970, G.V. Subba Rao 36610 (MH), Kodanad, near water tank 27.1.1972, E. Vajravelu 39650 (MH), way to Sirur from Ebanad, 23.3.1972, G.V. Subba Rao 40536 (MH), Pykara, Swamp near shola, 22.6.1986, M.K. Janarthanam 83005 (MH).

UTTAR PRADESH: Dehra Dun, Rajpur, 1.10.1961, Hari Om Saxena 2288 (DD), 15.9.1965, C.R. Babu 34942 (BSD), Pine Plantations, 3.11.1974, H.B. Naithani 221 (DD), 28.11.1975, A.S. Rao 53707 (BSD); Rajpur Road, 11.11.1976, A.S. Rao 53722 (BSD).

30. *Utricularia smithiana* Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 373. 1849 & Ic. t. 1577. 1850; Gamble, Fl. Madras 982. 1924 (2: 690. 1957 repr. ed.); Fyson, Fl. S. Ind. Hill St. 1: 437. 1932. - HOLOTYPE: Malabar or Coorg, Wight s.n. (K, Photo !). (Photo 21).

Utricularia caerulea var. smithiana (Wight) Clarke in Hook.
f. Fl. Brit. India 4: 331. 1884.

Utricularia graminifolia sensu Chandrasekaran in Henry
et al. Fl. Tamil Nadu I. 2: 130. 1987, p.p. non Vahl 1804.

Herbs; rhizoids up to 2 cm long, filiform, glandular, branches up to 6 mm long, papillose; stolons up to 3 cm long, filiform, branched. Foliar organs up to 15 x 2 mm, rounded at apex, 3-nerved, often nerves branched further. Traps c 1.5 mm across, globose; mouth basal; appendages 2, subulate. Racemes up to 45 cm long, erect, simple, grooved, glabrous, 1-7-flowered; scales c 2 x 1 mm, basifixed, lanceate, 3-nerved, acute to acuminate at apex; bracts 2.5-3.5 x 1.5-1.8 mm, basifixed, ovate, 3-5-nerved, acute to acuminate at apex; bracteoles 1-2 mm long, subulate, 1-nerved; flowers up to 15 mm long; pedicels 5-10 mm long, winged. Calyx-lobes unequal, glandular within, papillose without, denticulate along margins; upper lobe 4-7.5 x 4-5.5 mm, ovate, acuminate at apex; lower lobe 4-7 x 2.7-4 mm, lanceate, bidentate to 4-denticulate at apex. Corolla blue to violet, papillose; upper lip 4-6.5 x 4-5 mm, obovate to oblong, crested across on ventral side, ciliate along lower margin, rounded at apex; lower lip 10-16 x 11-19 mm, semiorbicular, hairy in throat, gibbous at base, rounded at apex; spur up to 7 mm long, conical, papillose within, acute at apex. Stamens c 2 mm long; filaments strap-shaped; anther thecae distinct. Pistil c 2.5 mm long; ovary ovoid; stigma bilipped, lips equal in size. Capsules 3.5-5 x

2.5-3 mm, ovoid, wall uniformly membranous; placenta 2-3 x 1.2-2 mm, ovoid. Seeds 0.2-0.35 mm long, subglobose to oblongoid; hilum terminal, prominent; testa reticulate, scrobiculate, cells elongate. (Fig. 32).

Fl. & Fr.: June-November.

Ecology: Along marshy places at high altitudes above 1000 m.

Distribution: Endemic to southern parts of W. Ghats; Tamil Nadu, South Karnataka and Kerala. (Map 9).

Notes: Utricularia smithiana Wight was treated either conspecific to U. graminifolia Vahl (Chandrasekaran l.c.), or treated as a variety or U. caerulea auct. (Clarke l.c.). But the larger flowers, absence of thickening along the dehiscent margin of capsule, and scrobiculate seeds clearly distinguish U. smithiana from U. graminifolia.

This species is restricted to higher altitudes of W. Ghats, from Kanniyakumari to Bill hills of Mysore. The specimens from Nilgiri resemble U. smithiana in their large-sized flowers, but they never set fruiting to confirm their identity. The occurrence of this species in Mysore is newly reported here.

Specimens examined:

KARNATAKA: Bill hills, Moskal, Dec. E. Barnes s.n. (DD, Acc. no. 103686), Devagiri, E. Barnes s.n. (DD).

KERALA: Quilon dist., Pamba Dam to Anathode, 1020 m, 9.11.1975, K. Vivekananthan 46573 (MH).

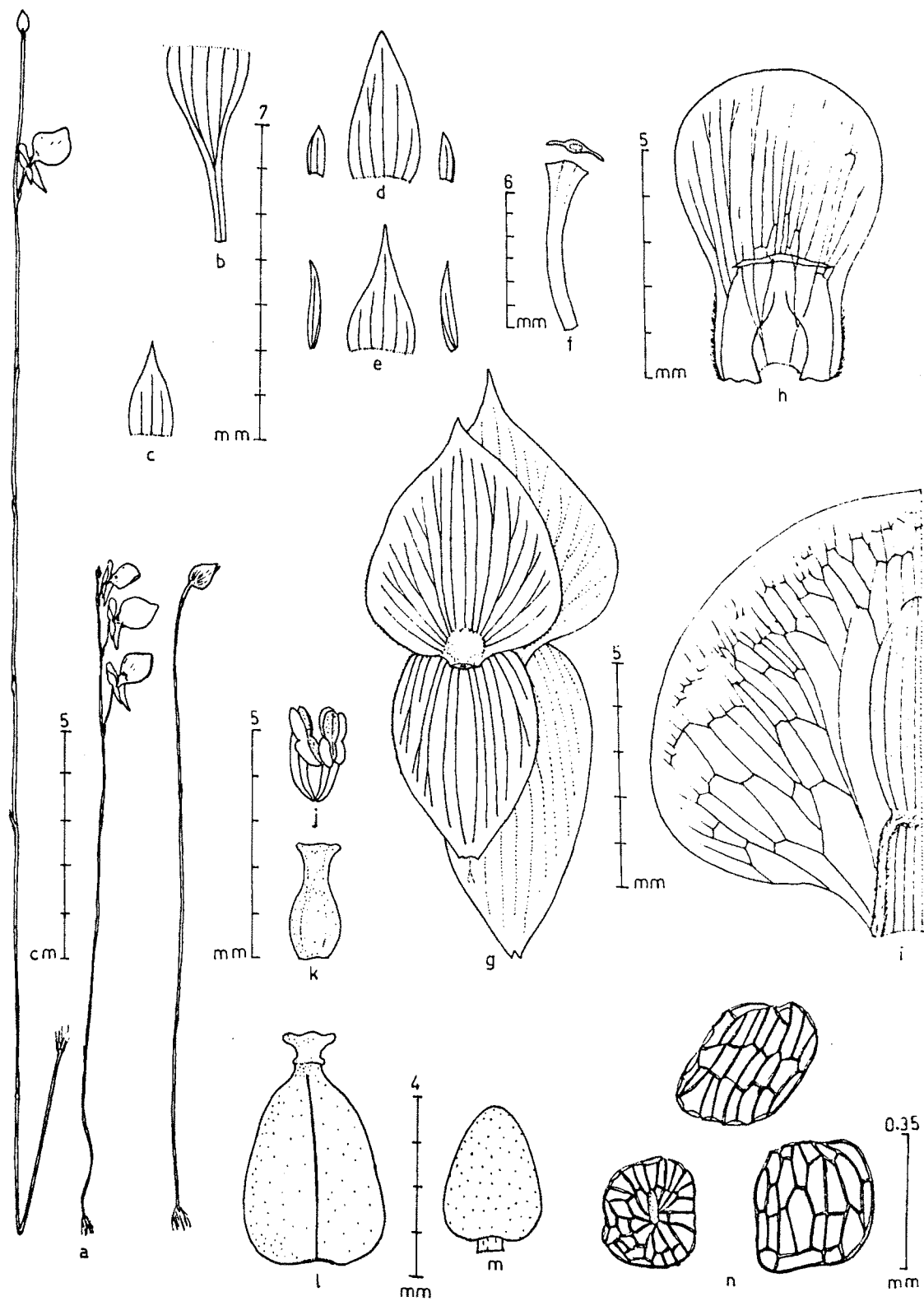


Fig. 32. *Utricularia smithiana* Wight: a. Plants; b. Foliar organs - a part; c. Scale; d, e. Bracts & bractoles; f. Fruiting pedicel with T.S.; g. Flowering and fruiting calyx; h. Corolla - upper lip; i. Corolla - lower lip (a portion); j. Stamens; k. Pistil; l. Capsule; m. Placentum; n. Seeds.



Photo 21. *Utricularia smithiana* Wight (Holotype - K).

TAMIL NADU: Anna dist., Kodaikanal, Lake side, 17.7.1898, A.G. Bourne s.n. (CAL; MH, Acc. no. 330123); Kanniyakumari dist., Kalivayalpil, 2.6.1901, C.A. Barber 3073 (CAL, MH), Muthukuzhivayal, 1400 m, 27.8.1976, A.N. Henry 47593 (MH), 9.9.1976, A.N. Henry 48315 (MH), way to Poovankulam, Agasthyamalai, 1100 m, 24.9.1980, A. N. Henry 68804 (MH).

31. *Utricularia stellaris* L.f. Suppl. Pl. 86. 1781; Roxb. Pl. Coromandel 2: 42. t. 180. 1798 & Fl. Ind. 1: 143. 1820 & ed. 2: 143. 1832; Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849 & Ic. t. 1567. 1850; Oliver in J. Proc. Linn. Soc., Bot. 3: 174. 1859; Dalzell & Gibson, Bombay Fl. 135. 1861; Drury, Handb. Ind. Fl. 2: 119. 1866; Clarke in Hook.f. Fl. Brit. India 4: 328. 1884, excl. var. inflexa (Forssk.) Clarke; Prain, Bengal Pl. 2: 581. 1903 (2: 581. 1963 repr. ed.); & in Rec. Bot. Surv. India 2: 326. 1903 & 3: 254. 1905; Cooke, Fl. Bombay 2: 316. 1905 (2: 389. 1958 repr. ed.); Duthie, Fl. Gangetic Plain 2: 166. 1911 (2: 38. 1960 repr. ed.); Rama Rao, Fl. Pl. Travancore 294. 1914; Saxton & Sedgwick in Rec. Bot. Surv. India 6: 286. 1918; Haines, Bot. Bihar Orissa 3 & 4: 644. 1922 (2: 675. 1961 repr. ed.); Gamble, Fl. Madras 980. 1924 (2: 689. 1957 repr. ed.); Santapau in J. Bombay Nat. Hist. Soc. 49: 217. 1950; Subramanyam, Aquatic Angio. 33. 1962; Maheswari, Fl. Delhi 255. 1963; Basak in Bull. Bot. Surv. India 17: 99. 1975 (1978); Gandhi in Saldanha & Nicolson, Fl.

Hassan 565. 1976; Oommachan, Fl. Bhopal 282. 1977; Varma, Fl. Bhagalpur 286. 1981; Srivastava in J. Econ. Tax. Bot. 4: 191. 1983; Singh, Fl. Bansw. Rajasthan 173. 1983; Rani & Matthew in Matthew, Fl. Tamilnadu Carnatic 3: 1123. 1983; Guha Bakshi, Fl. Murshidabad 232. 1984; Sharma et al. Fl. Karnataka 196. 1984; Ugemuge, Fl. Nagpur 273. 1986; Chandrasekaran in Henry et al. Fl. Tamil Nadu 2: 131. 1987. - HOLOTYPE: INDIA. Coromandel, Koenig s.n. (LINN, Photo !). (Photo 22).

Utricularia stellaris L.f. var. coromandeliana A. DC. in DC. Prodr. 8: 3. 1844. - TYPE: INDIA.t. 180, Pl. Coromandel 1798.

Utricularia macrocarpa Wall. ex Clarke in Hook.f. Fl. Brit. India 4: 328. 1884, pro. syn.

Utricularia inflexa Forssk. var. stellaris (L.f.) Taylor
Muenchen
in Mitt. Bot. Staatssamml 4: 96. 1961 & in Hutch. & Dalz. Fl. W. Trop. Africa ed. 2. 2: 380. 1963 & in Kew Bull. 18: 189. 1964, p.p. excl. syn. U. muelleri Kamienski; Abraham & Subramanyam in Proc. Indian Acad. Sci. 62B: 98. 1965; Maheswari, Ill. Fl. Delhi f. 158. 1966; Santapau & Janardhanan, Fl. Saurashtra 37. 1966; Ramasamy & Razi, Fl. Bangalore 548. 1973; Shah, Fl. Gujarat 1: 514. 1978; Bennet, Fl. Howrah 334. 1979; Manilal & Sivarajan, Fl. Calicut 207. 1982.

Herbs; rhizoids absent; stolons up to 60 cm long or more, glabrous, branched. Foliar organs up to 5 cm long; primary segments 3-5, semiverticillate; secondary segments

2 per point and repeatedly divided; ultimate segments capillary, terete, setulose; stipules if present up to 3 mm across, auriculate, segments setulose, cordate at base. Traps 1-2 mm across, obliquely ovoid, slightly compressed; mouth lateral, oblique; appendages usually 2, rarely more or altogether absent, simple or branched. Racemes up to 20 cm long, held above water level by floats, up to 12-flowered, flowers congested at anthesis; floats 2.5-25 x 2-5 mm, globose, ellipsoid to cylindrical, 3-10, verticillate, usually at middle of peduncle, rarely near base, reduced foliar-like segments attached at apex; bracts 1.5-3 mm long, basifixed, elliptic to ovate-deltoid, usually hyaline, 3-7-nerved, obtuse to truncate at apex. Flowers up to 8 mm long; pedicels 2-7 mm long, terete, distally thickened, erect at anthesis and recurved or reflexed in fruit. Calyx-lobes subequal, accrescent, fleshy, reflexed or rarely covering the capsule in fruit; upper lobe 3-3.5 x 2.5-3.3 mm (5-7 x 4-5 mm in fruit), ovate, acute to obtuse at apex; lower lobe 2-2.5 x 3-3.5 mm (up to 4 x 5 mm in fruit), suborbicular to transversely elliptic, rounded, truncate or retuse at apex. Corolla yellow, glandular hairy; upper lip c 4 x 3 mm, broadly ovate, emarginate, rounded or rarely truncate at apex; lower lip c 4 x 4 mm, more or less orbicular, hairy in throat, bigibbous at base, emarginate or crenate at apex; spur short, cylindrical, slightly curved, obtuse at apex. Stamens c 1.5 mm long; filaments dilated towards anther; anther thecae distinct.

Pistil c 1.5 mm long; ovary globose; style short, cylindrical; stigma 2-lipped, lower lip semiorbicular and hairy, upper lip 3-denticulate. Capsules (2-) 4-5 mm across, globose, circumscissile; placenta c 2 mm across, globose. Seeds 0.2-0.4 x 0.5-1 mm, prismatic, 4-7 angled, 2-4-times as wide as high, winged; hilum represented by a round scar, prominent; testa reticulate, cells elongate at sides and bottom of seed, and isodiametric at top. (Fig. 33).

Fl. & Fr.: August to April with a peak during October to February; late flowering in eastern parts of India compared to western parts.

Local name: Bengali - Jhangi; Mundari-Dajatanri; Telugu - Natsoo.

Ecology: Submerged floating in still or slow running water in ponds, tanks, lakes and rice fields; from sea-level upwards.

Distribution: From Africa to Australia through tropical Asia; in India distributed throughout except northern most and north-eastern states. (Map 9).

Chromosomes: $n = 21$ (Subramanyam & Kamble 1968).

Pollen: Isopolar, 15-18-colporate, synorate, 15-18-lobed in polar view, spindle shaped in equatorial view (Thanikaimoni 1966).

Notes: Utricularia stellaris L.f. being a widely distributed species, shows a higher degree of variation in the characters like number of foliar organs per point, presence or absence of stipule-like auricles at base of

foliar organs, size and shape of floats and their position of attachment on peduncle, and size of capsules.

The specimens with large floats are often erroneously referred to U. inflexa Forssk. in Indian literature.

Specimens examined:

ANDHRA PRADESH: Godavari, Yeleswaram, 13.12.1916, s.l. 12717 (MH), Samalkot, 22.12.1924, G.V. Narayana s.n. (MH, Acc. no. 81951); W. Godavari, Kolleru lake, 22.1.1958, K. Subramanyam 5061 (MH); Warangal, Pakhal, 28.2.1963, A.N. Henry 15955 (MH).

ASSAM: S.N. Bal 247 (CAL).

HARYANA: Hissar dist., Chakaranain, 26.10.1967, V.J. Nair 37660 (BSD, CAL).

KARNATAKA: Dharwar, 2,500 ft., Dec. 1916, L.J. Sedgwick 1931 (BLAT, PCM), Tadas, 2000 ft., Mar. 1917, L.J. Sedgwick 2317 (BLAT).

KERALA: Malabar, Stocks & Law (MH, Acc. no. 36521).

MADHYA PRADESH: Rewa, Jari, 14.12.1953, Kaul & party 5001 (LWG); Jhansi, 28.12.1954, Kaul & party 17750 (LWG); Satna, Lagargawan, 21.9.1959, K.M. Sebastine 8921 (CAL, MH).

MAHARASHTRA: Malwan, Nov. 1892, Cooke ? s.n. (BSI, Acc. no. 54048; BLAT; CAL, Acc. no. 329965); Thana, Nirmal tank, 31.10.1907, H.P. Paranjpe s.n. (BSI); Kaira, 3.12.1907, H.M. Clubber s.n. (BSI); Kurul, Pond near Alibag, 14.2.1917, Moses Ezekiel 54067 (BLAT), 16.12.1917, Moses Ezekiel 54068 (BLAT); Borivli to Kawai caves, 31.1.1942, H. Santapau 1518,

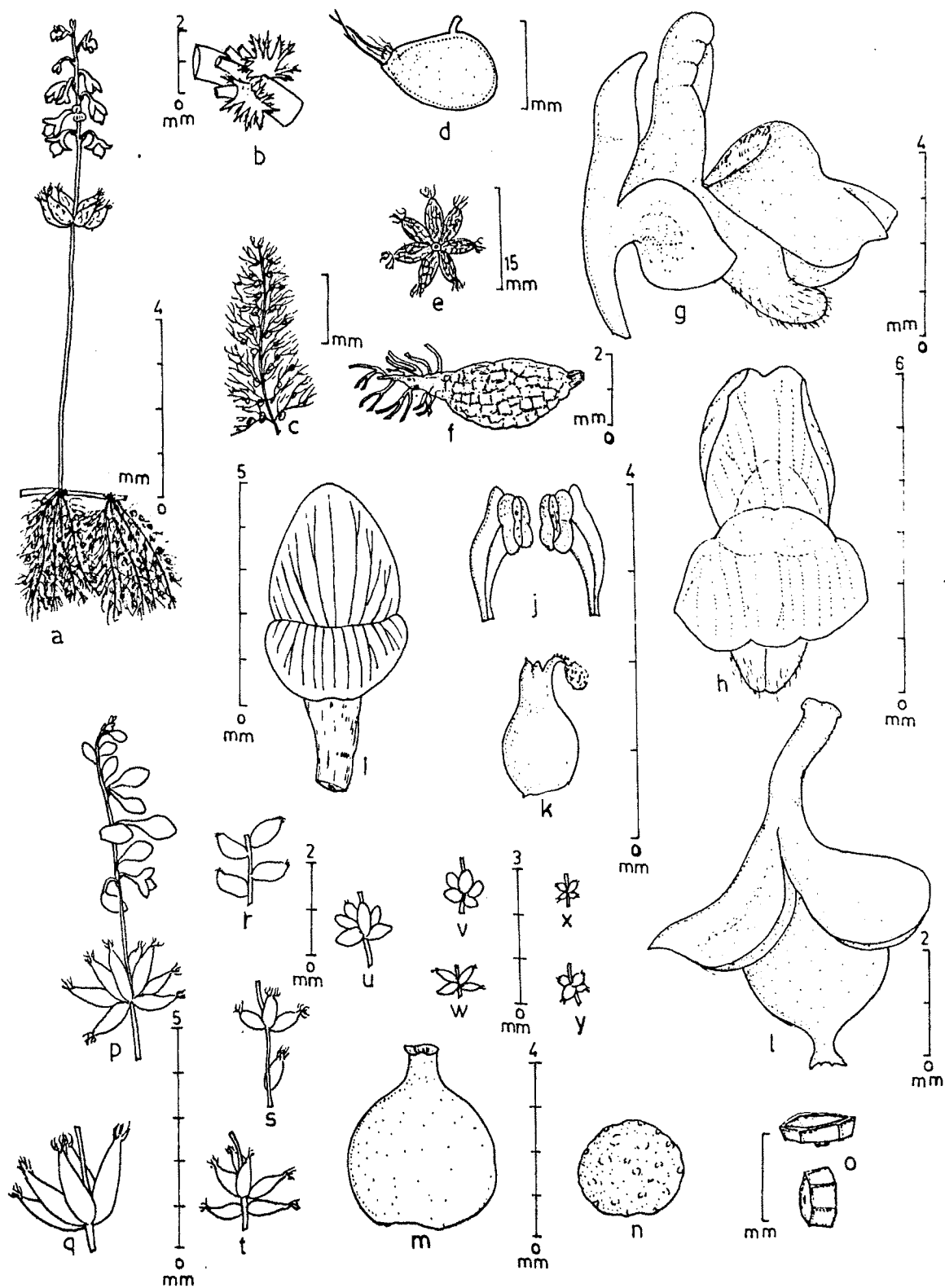


Fig. 33. *Utricularia stellaris* L.f.: a. Plant; b. Auricles at base of foliar organs; c. Foliar organ; d. Trap; e. Floats; f. Single float; g. Flower - lateral view; h. Flower - front view; i. Calyx with pedicel; j. Stamens; k. Pistil; l. Fruit with calyx; m. Capsule; n. Placenta; o. Seeds; p-y. Floats.



Photo 22. *Utricularia stellaris* L.f. (Holotype -LINN).

1519 (BLAT); National Park, Borivli 24.8.1953, A.J. Randeria A.R. 548 (BLAT), 26.9.1953, A.J. Randeria A.R. 557 (BLAT), 26.9.1953, H. Santapau 16068, 16069, 16070 (BLAT); Mumbra, 13.10.1953, K.V. Shenoy KVS 812 (BLAT), 24.10.1953, K.V. Shenoy KVS 957 (BLAT); Borivli National Park, 14.11.1953, G.J. Kapadia 236 (BLAT); Mumbra, 28.11.1953, G.J. Kapadia 292 (BLAT), Nagpur, Dahegaon lake, 5.12.1954, M. Firashi 97 (BLAT); Madh-Island, Andheri, Bombay, 11.12.1955, G.L. Shah 6564, 6566 (BLAT); Madh-Island, Bombay, 2.12.1956, G.L. Shah Shah 8128 (BLAT).

ORISSA: Chandipur coast, 29.11.1965, T.A. Rao E 5633 (CAL).

PUNJAB: Chakka jhil Sirsa, 2.12.1961, N.C. Nair 18975 (BSD, CAL), 18995 (BSD), Oto bridge, Sirsa, 2.12.1961, N.C. Nair 18973 (BSD, CAL); Panipat, 16.10.1962, N.C. Nair 24725 (BSD); Hoshiarpur dist., Lohara, 7.9.1970, O.P. Misra 41743 (BSD, CAL).

RAJASTHAN: Dilwara, Mt. Abu, Oct. 1916, Bl. & Hall 22554 (BLAT); Bansevara, 17.4.1963, D.M. Verma 215 (CAL); Bharatpur lake, 20.10.1963, N.D. Bachkheti (DD, Acc. no. 140598); Sainavasa vill, Loharia tank, 17.10.1976, V. Singh 3709 (BSJO, CAL); Bhilwara, Bijolia, 30.9.1978, A.N. Singh 6084 (BSJO, CAL).

TAMIL NADU: South Arcot, Annamalainagar, 20.12.1949, C. Balakrishnan s.n. (LWG, Acc. no. 2732); Thanjavur, Sirka-zhi-Poompukar, 26.1.1978, K. Ramamurthy 53607 (CAL, MH), Valampuri, 15.9.1979, K. Ramamurthy 64106 (CAL, MH).

UTTAR PRADESH: Mathura dist., Parkham, Oct. 1950, R.C. Bharadwaja s.n. (LWG, Acc. no. 111781), 1952, R.C. Bharadwaja (LWG, Acc. no. 8497); Sultanpur Road, 7.1.1953, Umashankar Misra (LWG, Acc. no. 247); Mailani, 17.12.1960, C.L. Malhotra 13356 (BSD); Daulatabad, 22.10.1962, N.P. Singh 25388 (BSD, LWG); Mirzapur, Robertsganga Road, 21.10.1964, G. Panigrahi 3678 (CAL).

W. BENGAL: Lower Bengal, S. Kurz s.n. (CAL, Acc. no. 329967); Calcutta, Indian Botanic Garden, Sibpur, 8.11.1956, G. Saran & party 37873 (LWG); Bundlekund, 15.10.1959, Vicary s.n. (CAL, Acc. no. 329968); Shonarpur, 7.9.1963, B.V. Shetty 73 (CAL); Bankura dist., Simlapal, 7.9.1982, M.N. Sanyal 1418 (CAL).

32. *Utricularia striatula* Smith in Rees, Cyclop. 37: n. 17. 1819; Cooke, Fl. Bombay 2: 320. 1905 (2: 393. 1958 repr. ed.); Gamble, Fl. Madras 983. 1924 (2: 691. 1957 repr. ed.); Fyson, Fl. S. Ind. Hill St. 1: 438. 1932 & 2: t. 378. f. 4. 1932; Santapau in J. Bombay Nat. Hist. Soc. 49: 220. 1950 & Fl. Purandhar 94. 1957 & in Rec. Bot. Surv. India 16(1); 187. 1967; Taylor in Kew Bull. 18: 91. 1964 & in Steenis, Fl. Males. I. 8: 289. 1977; Santapau & Janardhanan, Fl. Saurashtra 37. 1966; Hara, Fl. E. Himal. 300. 1966; Arachi, Pict. Pres. Indian Fl. 131. t. 133. 1968; Basak in Bull. Bot. Surv. India 17: 105. 1975 (1978); Gandhi in Saldanha & Nicolson, Fl. Hassan 565. 1976; Babu, Herb. Fl. Dehra Dun 369. 1977; Raizada & Saxena, Fl.

Mussoorie 1: 526. 1978; Shah, Fl. Gujarat 1: 515. 1978; Raghavan et al. in Rec. Bot. Surv. India 2: 63. 1981; Yoganarasimhan et al. Fl. Chikmagalur 241. 1981; Balakrishnan, Fl. Jowai 2: 341. f. 19. 1983; Rani & Matthew in Matthew, Fl. Tamilnadu Carnatic 1123. 1983; Mukerjee, Fl. Pachmarhi & Bori Res. 218. 1984; Naithani, Fl. Chamoli 2: 478. 1985; Mehrotra & Chakraborty in J. Econ. Tax. Bot. 6: 414. 1985; Rao, Fl. Goa 2: 309. 1986; Chandrasekaran in Henry et al. Fl. Tamil Nadu I. 2: 131. 1987. - TYPE: Sierra Leone, Afzelius s.n. (BM, BR, LD, LINN, S).

Meloneura purpurea Raf. Fl. Tell. 4: 109. 1838.

Utricularia pusilla Graham, Cat. Pl. Bombay 165. 1839, non Vahl 1804. - TYPE: none cited.

Utricularia orbiculata Wall. ex A. DC. in DC. Prodr. 8: 18. 1844; Oliver in J. Proc. Linn. Soc., Bot. 3: 187. 1859; Dalzell & Gibson, Bombay Fl. 136. 1861; Drury, Handb. Ind. Fl. 2: 126. 1866; Clarke in Hook. f. Fl. Brit. India 4: 334. 1884; Rama Rao, Fl. Pl. Travancore 294. 1914. - TYPE: Nepal, Wallich (CAL !, G, K).

Utricularia glochidⁱata Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 373. 1849 & Ic. t. 1581. 1850. - TYPE: Sri Lanka; none cited.

Meloneura striatula (Smith) Barnh. in Mem. New York Bot. Gard. 6: 50. 1915.

Herbs; rhizoids up to 2.5 cm long, simple, few or altogether absent; stolons up to 9 cm long, simple, rarely branched, glandular. Foliar organs with pseudopetiole up to

15 mm long, orbicular to obovate, rosulate at scape base, scattered on stolons, expanded portion up to 5 mm across, veins dichotomously branched. Traps up to 1.5 mm across, globose to obliquely ovoid; mouth lateral; appendages glandular hairy, on expanded, divergent upper lip. Racemes up to 18 mm long, erect, often zigzag, glabrous, up to 10-flowered; scales if present 1-1.5 mm long, medifixed; bracts 0.6-2 mm long, medifixed, constricted at middle, limbs unequal; bracteoles 0.7-1.5 mm long, medifixed, limbs unequal; flowers up to 10 mm long; pedicels 1.5-7 mm long, filiform, spreading in anthesis, spreading or recurved in fruit, papillose at least in fruiting. Calyx-lobes highly unequal, papillose; upper lobe 1.2-4 x 2-4 mm, obovate to obcordate, emarginate, truncate or obtuse at apex; lower lobe 0.6-2 x 0.4-2 mm, oblong to ovate, truncate, notched or rounded at apex. Corolla pink, lilac, violet, white to variously tinged, often yellow-blotched near base; upper lip 0.6-2 mm across, semiorbicular to deltoid, bidentate, truncate or irregular at apex; lower lip 3-7 x 3-10 mm, 3- or 5-lobed, throat hairy, base raised or flat, rounded or truncate at apices of lobes; spur 1-6 mm long, cylindrical or conical, rarely reduced to a mound, obtuse, acute or retuse at apex. Stamens up to 1.2 mm long; filaments strap-shaped, curved; anther thecae subdistinct. Pistil up to 1.2 mm long; ovary obliquely ovoid, attached to base of upper calyx-lobe; style distinct; stigma 2-lipped, lower lip oblong to semiorbicular, upper lip obsolete. Capsules

1.5-3.5 mm long, obliquely ovoid, attached to upper calyx-lobe, keeled on ventral side, dehisce by a longitudinal ventral slit; placenta c 1 x 0.6 mm, flask-shaped. Seeds 0.3-0.4 mm long, clavate, cylindrical or oblongoid, attached radially to placentum, glochidiate. (Fig. 34; Photo 6B).

Fl. & Fr.: July-December (-February).

Ecology: Epiphytic or terrestrial; found on wet moss covered tree trunks, dripping rocks in shade, vertical face of wet rocks and less commonly on moss covered stone walls; from 150 m upwards, mostly in higher altitudes.

Distribution: Tropical Africa to China and Malesia through Sri Lanka and India; in India distributed almost throughout the country. (Map 9).

Pollen: Isopolar, tricolporate, circular in polar view, elliptic in equatorial view; 18-20 x 27-29 μ (Thanikaimoni 1966).

Notes: The allied species of Utricularia striatula Smith are distributed in the Himalayas, Khasi hills and Malesia; U. furcellata Oliver, perhaps is the closest ally (vide note under U. furcellata). The other species - U. kumaonensis Oliver, U. brachiata Oliver and U. multicaulis Oliver have comose seeds in contrast with glochidiate seeds of U. striatula.

The size and structure of corolla vary much in this species. The lower lip of corolla is either 5- or 3-lobed, the lobes are often obscure and the size always exceeds the size of calyx-lobes except in few extreme cases. The

spur is completely reduced forming a saccate structure, in few specimens collected from Lonavla, Maharashtra, and these plants cannot be treated distinct due to imperceptible gradation. The occurrence of cleistogamous flowers is high in this species. According to Killian (vide Taylor 1964) the cleistogamous flowers are seen in the plants which receive sunlight for a period of less than one hour per day. It was observed during this study that such plants are abundant on vertical side of rocks facing north where the sunlight is comparatively less, and on tree trunks where it never falls directly.

This widely distributed species was recently reported from Saddle Peak of Andaman Island by Mehrothra & Chakraborty (1985); U. exoleta R. Br. being the only other species recorded in the Andamans.

Specimens examined:

ANDHRA PRADESH: Chittoor dist., Avacharakona, Thirumalai, 14.10.1958, K. Subramanyam 6947 (CAL, MH).

BIHAR: S. Bihar, Neterhat Plateau, 1956, V. Chandra & party 44057 (LWG).

HIMACHAL PRADESH: Simla, Windsor Castle, 4000 ft., 28.8.1887, E.R. Johnson s.n. (CAL, Acc. no. 330343, 330344), Urla to Drang, 25.8.1977, S.K. Murti & Prasad 62057 (BSD).

KARNATAKA: Mysore, Cadamanery, 8.9.1903, C.A. Barber 6081 (MH); N. Kanara, 1909, T.D. Bell 2518 (BLAT); Tirthahalli, 18.9.1914, P.F. Fyson 3546 (PCM); Karwar, 1500 ft., Guddehalli hills, Oct. 1919, Ambo 6817 (BLAT), Kadia,

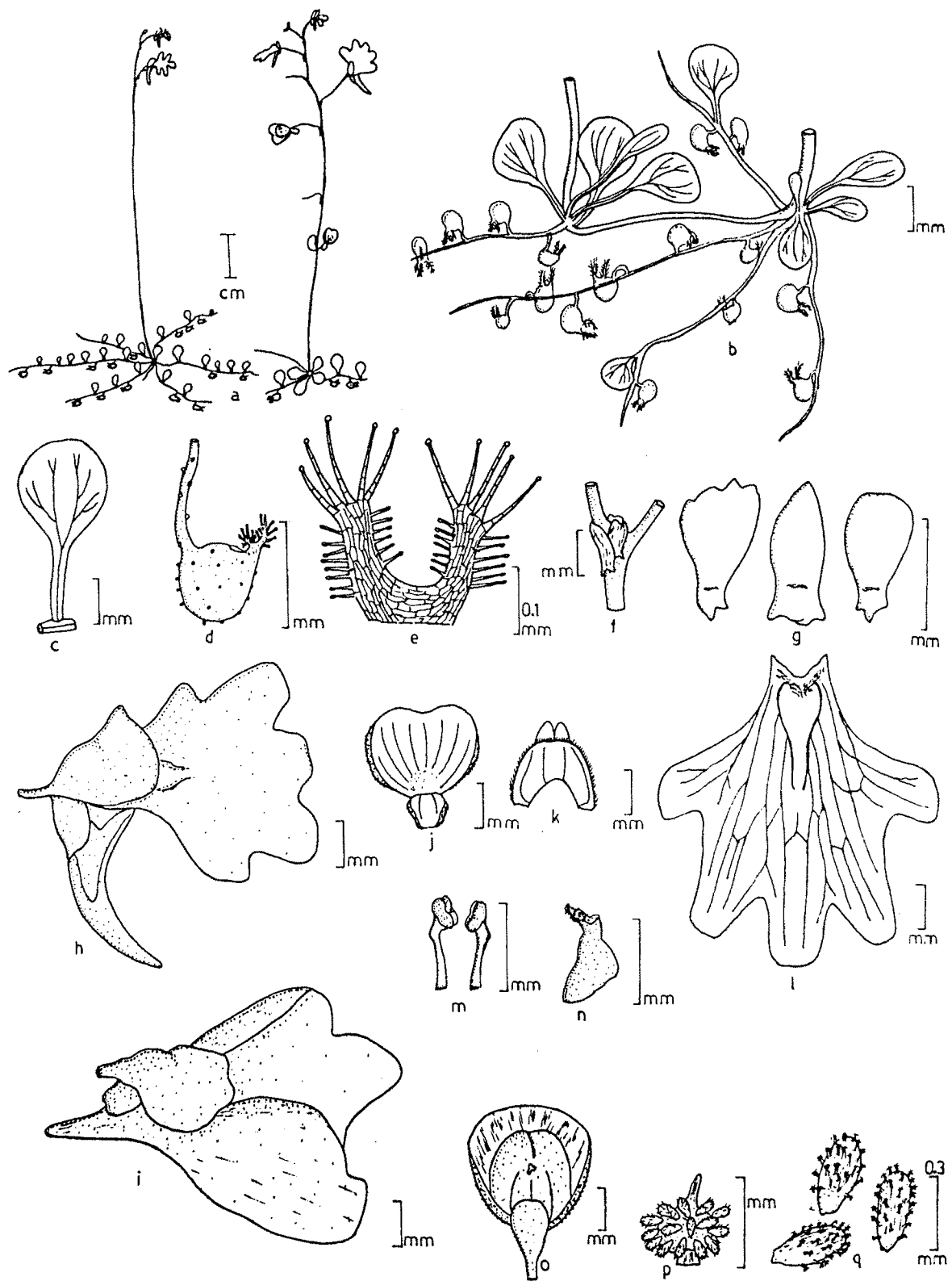


Fig. 34. *Utricularia striatula* Smith: a. Plants; b. Scape base; c. Foliar organ; d. Trap; e. Appendages of trap; f. Bract & bracteoles - on peduncle; g. Bract & bracteoles; h, i. Flowers; j. Calyx; k. Corolla - upper lip; l. Corolla - lower lip; m. Stamens; n. Pistil; o. Fruit; p. Placenta with seeds; q. Seeds.

Sept. 1918, T.D. Bell 5390 (BLAT); Jog falls, 2.10.1928, P.F. Fyson 6568 (PCM); Agumbe, 30.8.1963, R.S. Raghavan 90300 (BSI); S. Kanara, Dharmasthala, 28.7.1978, Cecil J. Saldanha, S.R. Ramesh & N.S. Ravindra KFP 1980 (CAL).

KERALA: Malabar, Stocks & Law s.n. (MH, Acc. no. 36632); Wynaad, Devala, Sept. 1900, C.A. Barber 2035 (MH), Idikki dist., Lockhart gap-Devicolam, 12.10.1963, K.M. Sebastine 17544 (CAL, MH); Kuttikanam-Peermade, 27.9.1964, K. Vivekananthan 21430 (MH); Palghat dist., Mukkali, 14.10.1965, E. Vajravelu 26236 (CAL, MH); Thenkanchi, 23.9.1972, B.D. Sharma 40850 (MH); Trivandrum dist., Kottur R.F., 25.9.1973, J. Joseph 41977 (MH); Idikki dist., Kozhikkannam, 11.11.1975, K. Vivekananthan 46749 (CAL, MH); Trichur dist., Adirappilli, \pm 175 m, 13.9.1976, K. Ramamurthy 48492 (CAL, MH); Palghat dist., Ayyappan Kovil area, 26.10.1976, E. Vajravelu 48708 (CAL, MH); Idikki dist., Thadiampadu, 24.8.1977, K. Vivekananthan 50509 (CAL, MH); Quilon dist., Ranni, 31.8.1977, N.C. Nair 50733 (CAL, MH); Moozhia, 3.9.1977, N.C. Nair 50871 (CAL, MH); Palghat dist., Panthanthode, 21.9.1977, J. Joseph 51443 (CAL, MH); Silent Valley, 24.9.1977, R. Ansari 51470 (CAL, MH); Trivandrum dist., Ponmudi, 975 m, 31.7.1978, M. Mohanan 58509 (CAL); Palghat dist., Silent Valley, Hanging bridge area, 5.10.1979, N.C. Nair 64260 (MH); Mukkali, 11.10.1979, N.C. Nair 64521 (CAL, MH); Kasaragod dist., Vellarikundu, 22.8.1985, M.K. Janarthanam 82925 (MH), Beemanadi, 22.8.1985, M.K. Janarthanam 82928 (MH).

MAHARASHTRA: Satara dist., Mahableshwar, 4,500 ft., Nov. 1918, L.J. Sedgwich 4538 (BLAT); Pune dist., Lonavla, Nov. 1925, R.D. Acland, ACK 861 (BLAT); Khandala, 5.9.1941, H. Santapau 151.1/482 A (BLAT); Khandala, 4.9.1942, H. Santapau 829 (BLAT), 5.9.1942, H. Santapau 836 (BLAT); Khandala station, 23.8.1943, H. Santapau 2478(2) (BLAT); Khandala, 22.8.1944, H. Santapau 4735 (BLAT), 8.9.1944, H. Santapau 4815 (BLAT), 4.8.1945, H. Santapau 6862 (BLAT), 8.7.1951, H. Santapau 12941 (BLAT), 3.9.1951, H. Santapau 13291 (BLAT); Junnagadh, Girnar hills, 24.8.1952, P.V. Bole BOLE 694 (BLAT); National Park, Borivli, 26.8.1952, A.J. Randeria AR 365 (BLAT); Khandala, 21.9.1952, H. Santapau 15019, 15020 (BLAT), 21.8.1953, H. Santapau 15810 (BLAT), 22.8.1953, H. Santapau 15846 (BLAT); National Park, Borivli, 26.9.1953, A.J. Randeria AR 558 (BLAT); Khandala, 24.7.1954, C. Saldanha CS 1336 (BLAT); St. X. Villa, Khandala, 28.8.54, H. Santapau 18985 (BLAT), Ahwa, Dangs, 8.9.1954, H. Santapau 19405 (BLAT); Pimpri to Ahwa Dange, 25.10.1955, H. Santapau 20220-20222 (BLAT); Khandala, 7.9.1956, H. Santapau 21145 (BLAT); Khandala, 29.8.1957, Y.A. Merchant 185 (BLAT); Nerat Matheran, 13.8.1959, N.A. Irani 4374, 4375 (BLAT); Khandala, 28.8.1960; C. Saldanha CS 5728 (BLAT); Jummapatti-Water pipe Matheran, 2.9.1960, N.A. Irani NI 5182 (BLAT); Dasturi pt. 17.9.1960, N.A. Irani NI 5412 (BLAT); Ratnagiri, Ambaghat, 17.9.1961, C. Saldanha CS 7179 (BLAT); Khandala, 10.7.1966, M.R. Almeida 408 (BLAT); 1967, M.R. Almeida s.n. (BLAT, Acc. no. 54100),

Pune dist., Lonavla, Valvan dam, 18.8.1964, B. Venkata Reddi 98642 (BSI); Thana dist., Dahisar, Tak-mak hill top, 16.9.1968, K.V. Billore 116747 (BSI), Igatpuri, 13.9.1962, R.S. Rao 81399 (BSI), Harichandragarh Taramati Hill, 28.9.1970, B.M. Wadhwa 127776 (BSI); Pune dist., Lonavla, Varshav temple, 11.10.1985, M.K. Janarthanam 82955 (MH); Bushy hills, 13.10.1985, M.K. Janarthanam 82959 (MH).

MEGHALAYA: Khasia mountains, J.D. Hooker & T. Thomson s.n. (MH, Acc. No. 69357); Khasi hills, Laitlyngkot 6000 ft., 20.7.1946, F. Kingdon-Ward 22 (CAL).

NAGALAND: Naga hills, Aug. 1886, D. Prain s.n. (CAL, Acc. no. 330347, 330349); Kohima, 1886, D. Prain s.n. (CAL, Acc. no. 330348).

ORISSA: Ganjam dist., Mahendragiri, Sept. 1903, C.E.C. Fischer s.n. (CAL, Acc. no. 330339); Keonjhar state, Sirka-gutu, 2.10.1946, H.F. Mooney 2766 (DD).

RAJASTHAN: Aboo, 1878, G. King s.n. (CAL).

TAMIL NADU: Pulneys, Kodaikanal, Church Cliff path, 5.12.1898, Bourne 2842 (MH); Coimbatore, Anamalai Hills, Attakkatti, 3400 ft., 30.12.1911, C.E.C. Fischer 3234 (CAL); Tirunelveli, Mahendragiri, 17.9.1916, s.l. 13151 (MH); M^adurai dist., Highway mountains, 9.9.1925, K.C. Jacob 17647 (MH); Tirunelveli, Courtallam, Shenbagadevi Arivi, 28.10.1954, E. Govindarajulu & B.G.L. S^wamy 70 (PCM), Courtallam, Chitra-ruvi, 15.12.1957, K. Subramanyam 4931 (MH), Mundanthurai, Kadavettiparai, 8.2.1958, E. Govindarajulu & B.G.L. S^wamy

2364 (PCM); Madurai dist., Near Periyar Dam, 19.10.1959, K. Subramanyam 9455 (CAL, MH); Coimbatore dist., Siruvani, Mylon's Bungalow, 14.8.1960, A.N. Henry ANH 326 (MH), 27.8.1961, A.N. Henry ANH 1609 (BLAT), Anamalais, 12.9.1961, J. Joseph 13303 (MH), Sholaiyar submergible area, 30.7.1963, K.M. Sebastine 17298 (CAL, MH); Kanniyakumari dist., Mahendragiri grassy slopes, 11.9.1969, B.V. Shetty 32355 (MH); Tirunelveli dist., Thulakkamparai, Panchavadi falls, 28.11.1969, B.V. Shetty 32949 (CAL, MH); Coimbatore dist., Akkamalai estate, Anamalais 21.9.1971, K. Periyasamy 29395 (MH); Kanniyakumari dist., Upper Kodaiyar, near Valve house, 7.8.1977, A.N. Henry 49642 (CAL, MH); Coimbatore dist., Anamalais, Sholaiyar Dam, 22.2.1985, M.K. Janarthanam 82901 (MH).

UTTAR PRADESH: Dehra Dun, Ambui Junt, 2000 ft., Nov. 1891, J.S. Gamble 23382 (CAL); Mussoorie, Halfway house, 5.9.1934, R.R. Stewart 14584 (DD); Mussoorie, Jharipani, 8.9.1935, M.B. Raizada 5501 (DD); N.W. Frontier, Landsdowne, 4,500 ft., 30.8.1942, D.G. Lowndeo 726 (CAL); Mussoorie, 7000 ft., 24.8.1958, K.M. Vaid, M-140 (DD), Phata, 1500 m, 21.9.1958, M.A. Rau 6452 (pp) (BSD); Joshimath-Pandukshwn, 1800 m, 2.10.1959, M.A. Rau 10419 (BSD); Mussoorie, near Savoy hotel, 7.10.1960, H.O. Saxena 1374 (DD); Dehra Dun, Rajpur, 10.9.1961, H.O. Saxena 2196 (DD), Bindal and Rober's Cave, 10.9.1964, C.R. Babu 34088 (BSD); Garhwal, Kund Chetty, 15.10.1965, N.C. Nair 35926 (BSD, CAL); Kumaon, Almorah dist., Thal-Beringa Road, 900 m, 27.8.1968, C.M. Arora

38804 (BSD, CAL), Bridal Path, Dadihat-Narayan Nagar, 1800 m, 30.8.1968, C.M. Arora 38818 (BSD, CAL), Tepim-Quiti, 29.8.1969, Pant & Naithani 38567 (BSD), Lilam-G. Valley, 1500 m, 2.9.1969, Pant & Naithani 39559 (BSD), Kumaon, Thal, 1500 m, 6.8.1970, C.M. Arora 41403 (BSD, CAL); Garhwal, Mondal, 1650 m, 2.10.1970, B.D. Naithani 42017 (BSD, CAL); Kumaon, Askat, 1.9.1971, C.M. Arora 45475 (BSD); Pithogardh dist., Askot-Narayan Nagal bridal path, 1500 m, 27.9.1975, C.M. Arora & R. Prasad 56570 (BSD); Almora dist., Gugniani Forest, 4473 ft., 13.10.1975, B.M. Wadhwa 57634 (BSD); Chamoli dist., Chandrapuri-Gupta Kashi, 21.8.1978, G. Panigrahi & Wadhwa 65189 (BSD); Pithogarh dist., Tivaghat-Dam site, 1400 m, 10.9.1985, H.J. Chowdhery & S. Singh 76281 (BSD).

Madras presidency: P.F. Fyson 5418 (PCM); Orukomban, 19.9.1958, R. Indra 357 (PCM); Pipeline, 28.9.1958, P.B. Kamath 485 (PCM), E. Barnes s.n. (DD, Acc. no. 109916).

Concan, Gibson s.n. (CAL, Acc. no. 330337).

Castle Rock, 2000 ft., Oct. 1908, A. Meebold 6830 (CAL); Aug. 1874, 4500 ft., Gamble 3291A (CAL), Sept. 1888, G. King s.n. (CAL, Acc. no. 330340).

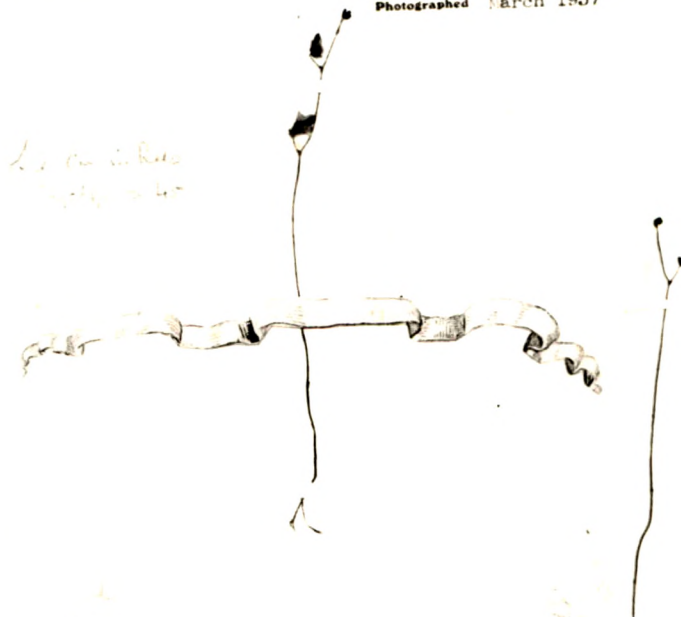
33. *Utricularia subulata* L. Sp. Pl. 18. 1753; Taylor in Kew Bull. 18: 81. 1964 & in Steenis Fl. Males. I. 8: 292. 1977. - HOLOTYPE: U.S.A., Virginia, Clayton (BM, Photo !). (Photo 23).

Utricularia stanfieldii sensu Joseph & Mani in Bull. Bot. Surv. India 24: 109. 1982; Joseph & Joseph, Insect. Pl. Meghalaya 25. 1986, non Taylor 1963.

Herbs; rhizoids up to 1 cm long, tapering towards apex, branches papillose; stolons up to 1 cm long, glandular, branched. Foliar organs up to 1 cm long, linear, 1-nerved. Traps up to 0.5 mm across, ovoid; mouth lateral; appendages 2, filiform, branched. Racemes up to 8 cm long, zigzag, terete, papillose at lower half, 1-3-flowered; scales up to 1 x 0.4 mm, medifixed, linear-elliptic, papillose, ciliate along margins, acuminate at apex; bracts c 0.5 mm across, peltate, broadly ellipsoid to orbicular, smooth; flowers 5-10 mm long; pedicels 1-2 mm long, terete. Calyx-lobes subequal, ovate, obtuse to acuminate at apex, nerves prominent; upper lobe c 1.3 x 0.7 mm, lower c 1 x 1 mm. Corolla yellow; upper lip c 2.5 mm long, ovate to orbicular, obtuse to rounded at apex; lower lip c 3 mm across, 3-lobed, bigibbous at base, obtuse to truncate at apices of lobes; spur up to 4 mm long, glandular within, obtuse at apex. Stamens c 0.6 mm long; filaments curved; anther thecae confluent. Pistil c 0.7 mm long; ovary obovoid; stigma bilipped, upper lip obsolete, lower orbicular and ciliate. Capsules c 1 mm across, subglobose, opens by a ventral pore with lid; placenta c 0.4 mm across, subglobose. Seeds c 0.2 mm long, obovoid; testa reticulate, cells elongated. (Fig. 26k-t).

Fl. & Fr.: August.

Photographed March 1937



No. S. 27

A species of Wintergreen. Mr. Clayton ex Virginia A. 1734. B. 31.
pertinet ad Utricularias Amm. de quib. dillenus Cat. 4. fl. p. 145 et nov. pl. gener.
p. 15. tab. 6.

~~Utricularia~~ nectaria subulata. Utricularia flor. long. p. 6 Linn. 1 p.

pl. 2. p. 16. n. 5

Virginia-Clayton
Ex. Herb. Gronovia

Type Specimen

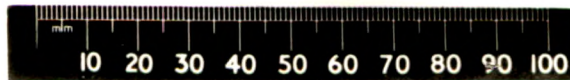


Photo 23. Utricularia subulata L. (Holotype - BM).

Ecology: On open moist sandy soil over rocks and stones.

Distribution: Eastern North America to Argentina in South and to Malesia through South Africa in East; and now reported from India. (Map 10).

Pollen: "23 x 20 μ . Ceinture 4 μ , traversee par 7-9 ectoapertures" (Huynh 1968).

Notes: Utricularia subulata L. is characterised by its branched appendages of traps, medifixed scales, peltate bracts, absence of bracteoles, prominently nerved calyx-lobes, and operculate capsule.

Taylor (1977) stated "-it is curious that this species (U. subulata L.), which is widespread and abundant in the New World, Africa and Madagascar, should never have been found in India. There can be no doubt that the Malesian plant is the same as the African and American ones". Joseph & Mani (1982) reported U. stanfieldii Taylor from Jarain, Meghalaya, India, which on critical examination show characters identical to U. subulata L. and not of U. stanfieldii Taylor. Thus the first report of U. subulata in India in this work solves the problem of 'missing link' in its distribution.

Specimens examined:

MEGHALAYA: Jarain, 11.8.1979, J. Joseph 50993 (ASSAM).

34. Utricularia uliginosa Vahl, Enum. Pl. 1: 203. 1804; Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849 &

Ic. t. 1574. (right hand fig. only) 1850; Gamble, Fl. Madras 981. 1924 (2: 689. 1957 repr. ed.); Fyson, Fl. S. Ind. Hill St. 1: 437. 1932; Santapau in J. Bombay Nat. Hist. Soc. 49: 218. 1950 & in Rec. Bot. Surv. India 16: 188. 1967 (repr. ed.); Ramasamy & Razi, Fl. Bangalore 549. 1973; Gandhi in Saldanha & Nicolson, Fl. Hassan 566. 1976; Taylor in Steenis, Fl. Males. I. 8: 282. 1977; Manilal & Sivarajan, Fl. Calicut 209. 1982; Sharma et al. Fl. Karnataka 196. 1984; Mukerjee, Fl. Pachmarhi Bori Res. 218. 1984; Rao, Fl. Goa 2: 309. 1986. - TYPE: INDIA, Koenig s.n. (C).

Utricularia affinis Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 373. 1849 & Ic. t. 1580 f. 1. 1850; Oliver in J. Proc. Linn. Soc., Bot. 3: 178. 1859; Drury, Handb. Ind. Fl. 2: 121. 1866; Hook.f. Fl. Brit. India 4: 330. 1884; Cooke, Fl. Bombay 2: 318. 1905 (2: 318. 1958 repr. ed.); Rama Rao, Fl. Pl. Travancore 294. 1914; Sharma et al. Fl. Karnataka 195. 1984. - TYPE: 1. Bombay, Lawson, 2. 'Nuls' (K, Photo !).

Utricularia brachypoda Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 373. 1849 & Ic. t. 1578. f. 1. 1850. - TYPE: INDIA. Quilon, June 1836, Wight s.n. (K, Photo !).

Utricularia griffithii Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 373. 1849 & Ic. t. 1576. 1850. - TYPE: Malacca, Griffith s.n. (K, Photo !).

Utricularia decipiens Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 279. 1851; Dalzell & Gibson, Bombay Fl. 135. 1861. - TYPE: INDIA. Bombay, Dalzell (K, Photo !).

Utricularia affinis Wight var. griffithii (Wight) Oliver
in J. Proc. Linn. Soc., Bot. 3: 179. 1859; Clarke in Hook.f.,
Fl. Brit. India 4: 331. 1884.

Herbs; rhizoids up to 2 cm long, capillary, tapering towards apex, branches 1.5 mm long, papillose; stolons up to 5 cm long, profusely branched. Foliar organs up to 8 x 1 cm, linear, rounded at apex, 3-nerved, nerves often branched further. Traps up to 1.5 mm across, subglobose, glandular; mouth basal; appendages 2, subulate, simple, glandular. Racemes up to 30 cm long, erect, terete, often grooved and winged, 1-6-flowered; scales 1-2 mm long, basifixed, ovate to deltoid, 3-nerved, acute at apex; bracts 1-2.5 mm long, basifixed, ovate to deltoid, 1-3-nerved, acute at apex; bracteoles 0.6-1.5 mm long, subulate; flowers up to 8 mm long; pedicels 1.5-7 mm long, winged, erect or spreading in fruit. Calyx-lobes more or less equal, ovate, margin denticulate; upper lobe 2.5-4 x 2.5-3 mm (up to 7.5 x 6 mm in fruit), acute to acuminate at apex; lower lobe 2.4-3.5 x 2-2.5 mm (up to 7.3 x 6 mm in fruit), 2-3-denticulate at apex. Corolla blue to violet or rarely pink; upper lip 3-4 mm long, oblong, slightly constricted at middle, crested on ventral side, hairy along lower margin, emarginate or truncate at apex; lower lip 4-6 x 2.5-4.5 mm, obovate to oblong, hairy in throat, gibbous, rounded or slightly 3-lobed at apex; spur 3-5 mm long, conical, acute at apex. Stamens c 1.5 mm long; filaments linear; anther thecae distinct. Pistil c 1.5 mm long; ovary ovoid,

slightly compressed; stigma bilipped, lower lip oblong and hairy, upper lip reduced to a small hemispherical structure. Capsules 3-4 x 2-3 mm, ovoid, wall uniformly membranous; placenta 1.5-3 x 1.2-2.2 mm, ovoid. Seeds c 0.4 mm across, subglobose to oblongoid; hilum terminal; testa reticulate, cells isodiametric to slightly oblong. (Fig. 35; Photo 5F).

Fl. & Fr.: Throughout the year with a peak in August-October.

Ecology: Along marshy places and near perennial water sources from sea-level to 2,500 m.

Distribution: Sri Lanka to Japan and Australia; in India distributed in Maharashtra, Karnataka, Kerala and Tamil Nadu along Western Ghats and W. Bengal (Map 10).

Pollen: Isopolar, tetracolporate, 4-lobed in polar view, elliptic in equatorial view; 25 x 30 μ (Thanikaimoni 1966).

Notes: Utricularia uliginosa Vahl is a highly variable species and often confused with U. graminifolia Vahl. The following table provides the distinguishing characters:

	<u>U. graminifolia</u> Vahl	<u>U. uliginosa</u> Vahl
Lower lip of		
corolla	bigibbous	unigibbous
Thickening	present	absent
on capsule		
Testa cells	much elongated	isodiametric or slightly elongated

The Tamil Nadu and Kerala specimens identified of late as U. praeterita Taylor are only an extreme form of U. uliginosa Vahl; U. praeterita is restricted to Maharashtra, Goa and Northern parts of Karnataka (vide Note under U. praeterita).

The variation in the size of foliar organs, racemes, pedicels, calyx-lobes and structure of seeds led the earlier botanists to erect numerous species. But, with the availability of a series of herbarium materials for study, the variation is recognised as continuous and hence many names are synonymised under U. uliginosa Vahl.

Specimens examined:

GOA: Castle rock, Sept. 1918, Bell 4290 (BLAT), Margao, Oct. 1908, A. Meebold 9797 (CAL).

KARNATAKA: Yellapore, 20.9.1884, W.A. Talbot 1046 (BSI, CAL); Karwar, 1.8.1885, W.A. Talbot 1284 (DD).

KERALA: Palghat dist., Malampuzha, 150 m, 30.5.1964, E. Vajravelu 19132 (MH); Idikki dist., Pachakanam, 850 m, 22.9.1972, B.D. Sharma 40835 (MH); Palghat dist., Kaikatty to Pothundy, 1000 m, 22.11.1973, E. Vajravelu 44791 (MH); Idikki dist., Kuttikanam, Peermade, 1050 m, 19.11.1975, K. Vivekananthan 46730 (MH); Quilon dist., Pamba to Anathode, 1050 m, 30.9.1976, K. Vivekananthan 48346 (MH); Trivandrum dist., way to Bonaccord, 525 m, 3.8.1978, M. Mohanan 58519 (CAL, MH); Cannanore dist., Manantoddy, 800 m, 7.3.1979, V.S. Ramachandran 62169 (MH); Palghat dist., Arumpara slopes - S.V.R.F. 850 m, 8.10.1979,

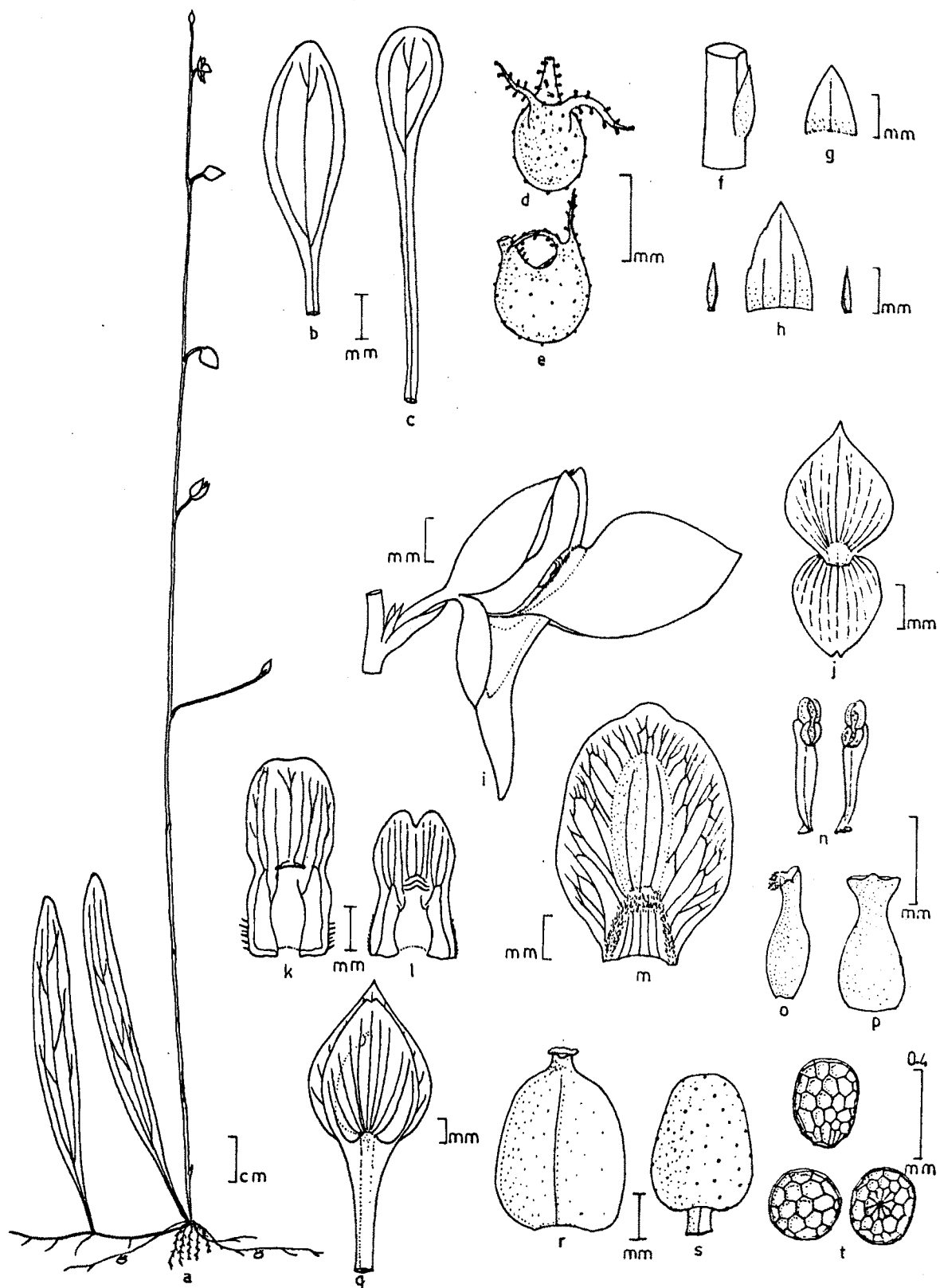
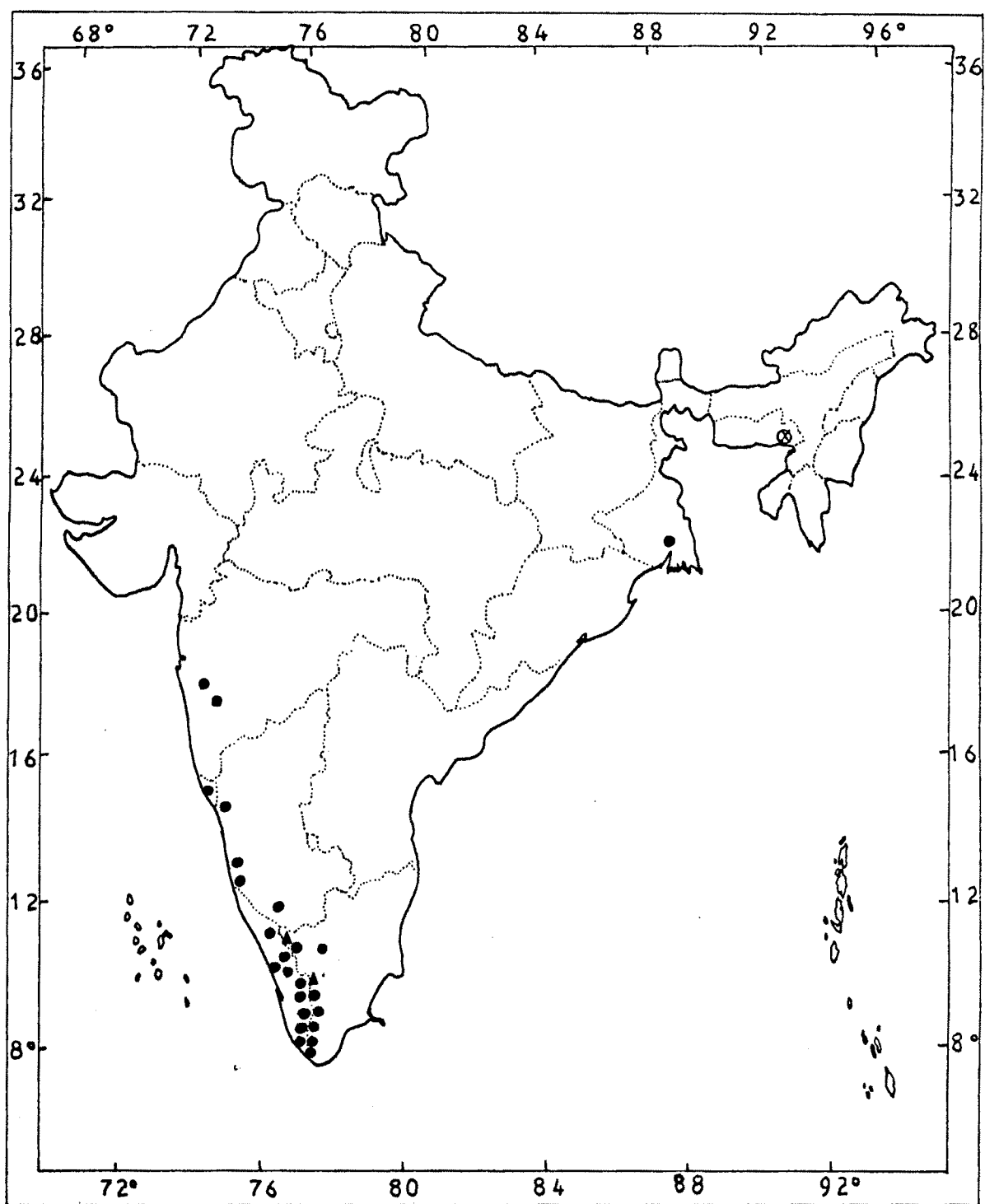


Fig. 35. *Utricularia uliginosa* Vahl: a. Plant; b, c. Foliar organs; d. Trap - front view; e. Trap - lateral view; f. Scale on peduncle; g. Scale; h. Bract & bracteoles; i. Flower; j. Calyx; k, l. Corolla - upper lip; m. Corolla - lower lip; n. Stamens; o. Pistil - lateral view; p. Pistil - adaxial view; q. Fruit; r. Capsule; s. Placenta; t. Seeds.



Map 10. Distribution: ● *Utricularia subulata* L.
 ● *U. uliginosa* Vahl
 ▲ *U. wightiana* M.K. Janarthanam

N.C. Nair 64421 (MH); Calicut dist., Iringal, 25.8.1985, M.K. Janarthanam 82932 (MH); Palghat dist., Malampuzha, 15.9.1985, M.K. Janarthanam 82937 (MH); Idikki dist., Lockhart gap, Kumali Road, 13.12.1985, M.K. Janarthanam 82965 (MH).

TAMIL NADU: Tirunelveli dist., Sengaltheri, 18.9.1914, s.l. 10882 (MH), River near Karamandiyamman temple, 1100 m, 9.3.1963, J. Joseph 15859 (MH); Nilgiri dist., View Point-Kodanad, 1800 m, 29.1.1972, E. Vajravelu 39678 (MH); Ramana-thapuram dist., Periyar river, near Naduthottam, Sethur hills, 1300 m, 11.3.1981, S.R. Srinivasan 68043 (MH); Tirunelveli dist., Kalakad, Sengaltheri to Kuliratti, 970 m, 21.5.1983, N. Parthasarathy 494 (MH); Coimbatore dist., Anamalai, Pannimedu estate, 24.2.1985, M.K. Janarthanam 82904 (MH), Muthumudi estate, 24.2.1985, M.K. Janarthanam 82905 (MH).

W. BENGAL: Calcutta, 1836-1838, John. W. Helfer s.n. (CAL, Acc. no. 330087).

35. *Utricularia wightiana* M.K. Janarthanam nom. nov.
- TYPE: as in U. squamosa Wight.

Utricularia squamosa Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 373. 1849 & Ic. t. 1579. 1850, non Benj. 1845; Gamble, Fl. Madras 982. 1924 (2: 690. 1957 repr. ed.); Sharma et al. in Biol. Mem. 2: 103. 1977. - HOLOTYPE: Sispara, Wight 2413 (K, Photo !).

Utricularia caerulea var. squamosa (Wight) Clarke in Hook.f.
Fl. Brit. India 4: 331. 1884.

Utricularia graminifolia sensu Chandrasekaran in Henry
et al. Fl. Tamil Nadu I. 2: 130. 1987, p.p. non Vahl 1804.

Herbs; rhizoids up to 1.5 cm long, branches c 1 mm long, papillose; stolons profusely branched. Traps c 1.5 mm across, subglobose; mouth basal; appendages 2, subulate. Foliar organs up to 25 x 4 mm, linear, 3-nerved, rounded at apex. Traps c 1.5 mm across, subglobose; mouth basal; appendages 2, subulate, simple. Racemes up to 25 cm long, erect, c 1 mm thick, terete, 1-3-flowered; scales 1-2 x 1-1.6 mm, basifixed, ovate, 3-nerved, numerous, free and not adpressed to peduncle, glandular on inner surface, acute at apex; bracts 2-2.5 x 1.5-2 mm, basifixed, ovate to lanceate, acute at apex; bracteoles 1-2 mm long, linear, 1-nerved, glandular on inner surface; flowers 8-15 mm long; pedicels 4-7 mm long, slightly winged. Calyx-lobes subequal, ovate; upper lobe 3.5-5.5 x 2.5-3.5 mm, acuminate at apex; lower 2.5-5 x 2.5-3 mm, bidentate at apex. Corolla blue; upper lip 3.5-5 mm long, linear, rounded at apex; lower lip 4-8 mm across, quadrate, gibbous at base, rounded or slightly emarginate at apex; spur 5-7 mm long, conical, curved and acute at apex. Stamens c 1.2 mm long; filaments strap-shaped, curved; anther thecae distinct. Pistil c 1.3 mm long; ovary ovoid; style flat; stigma 2-lipped. Capsules c 4 x 2.5 mm, ovoid, wall

uniformly membranous; placenta oblongoid. Seeds c 0.4 mm across, scrobiculate; hilum terminal; testa cells more or less isodiametric, cell walls separated by a space from testa except at corners. (Fig. 36).

Fl. & Fr.: January-April.

Ecology: At high altitudes from 1,600 m to 2,200 m in marshy areas of grasslands.

Distribution: Restricted to Nilgiri and Kodaikanal hills of Tamil Nadu and Attappadi hills of Kerala. (Map 10).

Notes: U. squamosa Wight was variously treated by earlier workers (vide synonymy). However, the numerous non-addressed scales on peduncle, absence of thickening along the dehiscent margin of capsule, and scrobiculate seeds with isodiametric testa cells are quite diagnostic and warrants a status of species.

U. wightiana M.K. Janarthanam is proposed as a new name for this species as the name U. squamosa Wight (1849) is a later homonym of U. squamosa Benj. (1845) (= U. caerulea L.). The specific epithet is after Robert Wight, who erected the species - U. squamosa.

Specimens examined:

KERALA: Palghat dist., Attappadi hills, 5,300 ft., 30.1.1911, C.E.C. Fischer 2513 (CAL).

TAMIL NADU: Nilgiri dist., April 1884, s.l. 36566 (MH); Anna dist., Poomparai-Kodaikanal, 2,200 m, 22.4.1965, K. Ramamurthy 23375 (MH); Nilgiri dist., Mudimund, 2,000 m, 6.2.1971, J.L. Ellis 37886 (MH).

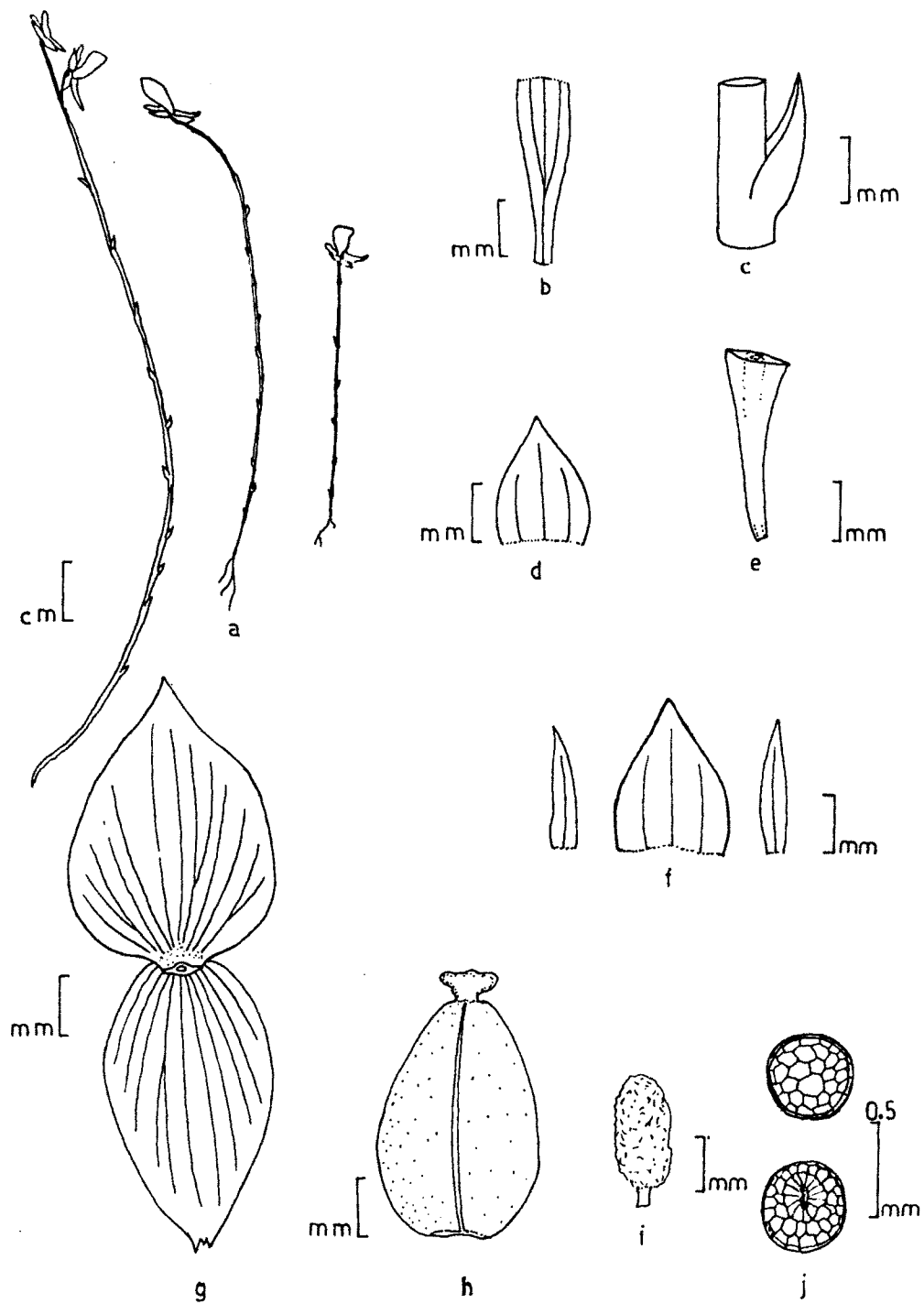


Fig. 36. *Utricularia wightiana* M.K. Janarthanam: a. Plants; b. Part of foliar organ; c. Scale on scape; d. Scale; e. Fruiting pedicel; f. Bract & bracteoles; g. Calyx; h. Capsule; i. Placentum; j. Seeds.

Imperfectly known species:

Utricularia alata Benj. in Bot. Zeitung (Berlin) 3: 212. 1845. Perhaps allied to U. bifida L.

Utricularia capillacea Willd. Sp. Pl. ed. 4, 1: 113. 1797.

The specimen described as U. capillacea Willd. and kept in Willdenow herbarium at Berlin is incomplete and hence its identity could not be ascertained.

Utricularia foveolata Edgew. in Proc. Linn. Soc. London 1: 351. 1848. Probably identifiable with U. minutissima Vahl. Taylor, ^{however} treats U. foveolata Edgew. (1848) and U. baouleensis A. Chev. (1912) conspecific. (vide CAL acc. no. 330160 - neotype of U. foveolata Edgew. proposed in July 1988)

Excluded species:

Utricularia inflexa Forssk., Fl. Aegypt.-Arab. 9. 1775. Reported in many Indian floras and florulas as a variety proper, or as a variety of U. stellaris L.f. The true U. inflexa could not be seen in any of the herbaria consulted for this work. The variation in the size, structure and position of floats and nature of fruiting calyxlobes in U. stellaris L.f. might lead to their misidentity with U. inflexa Forssk. Its reported occurrence in Assam (Gogoi & Sarma 1984) is doubtful as the "specimens exhibit U. stellaris L.f. characters in style and seeds." Hence, U. inflexa Forssk. is excluded from this treatment.

Utricularia stanfieldii Taylor in Taxon 12: 294. 1963. Joseph & Mani (1982) reported U. stanfieldii Taylor

from Jarain, Meghalaya, India. Critical examination of these specimens show characters identical to U. subulata L. and not of U. stanfieldii Taylor.

III CONCLUSIONS

III CONCLUSIONS

This work is the result of four years of intensive field and herbarium studies. In all, 35 species of Utricularia L. and one species of Pinguicula L. have been recognised for India. The nomenclature of all the species has been brought up to date by strict adherence to the International Code of Botanical Nomenclature (Voss 1983); further every attempt was made to check the identity of plants by way of "type method".

The intensive studies have resulted in the discovery of following new species:

Utricularia nayarii M.K. Janarthanam & A.N. Henry collected near Munnar, Idukki district of Kerala is allied to U. graminifolia Vahl, but is quite distinct in its flowers having shorter spur, the capsule wall uniformly membranous and the testa scrobiculate with more or less isodiametric cells.

Utricularia malabarica M.K. Janarthanam & A.N. Henry is related to U. lazulina Taylor, but differs in plants being smaller; calyx lobes equal and papillose; margin of upper corolla lip glabrous; lower lip of stigma hairy; fruiting pedicel recurved; seeds ovoid and testa smooth. This species was collected on laterite rocks from Mulleriya, Kasaragod district, Kerala.

Utricularia keralensis M.K. Janarthanam is allied to *U. bifida* L. but differs by its acute calyx lobes, presence of ligule at the base of lower lip and absence of striations in testa cells. Type specimens were collected from Pathanamthitta, Quilon district (now Pathanamthitta District) of Kerala.

Utricularia wallichiana Wight var. *firmula* Oliver has been redescribed as a new species - *U. recta* M.K. Janarthanam. It is allied to *U. scandens* Benj. but differs in its erect inflorescence and unequal fruiting calyx-lobes.

U. subulata L. is recorded for the first time in India.

Taxonomic position/status of several species has been altered after critical studies:

U. khasiana Joseph & Mani, growing in Ward lake of Shillong, Meghalaya in which flowering is yet to be observed, has been proved to be conspecific with *U. exoleta* R. Br. The structure and ramification of foliar organs, and the shape and position of traps as well as their affinity to dry black, suggest that the plant is only a variable form of *U. exoleta* R. Br.

Utricularia ogmosperma Blatter & McCann has been included in *U. albocaerulea* Dalzell.

Utricularia sampathii Subramanyam & Yoganarasimhan has been synonymised under *U. caerulea* L. sensu lato.

Utricularia tayloriana Joseph & Mani has been treated conspecific with U. hirta Klein ex Link.

U. reticulata Smith var. parviflora Santapau has been included in the species proper.

The species earlier treated conspecific due to inadequate details are reinstated:

U. multicaulis Oliver and U. kumaonensis Oliver were treated conspecific by Taylor (1982). He described them as having appendages on both the ends of seeds. But the present study shows that U. multicaulis has seeds with appendages on one side only. Hence they are treated distinct.

Utricularia roseopurpurea Stapf ex Gamble was treated synonymous to U. caerulea L. by Taylor (1977a). But, its larger flowers, shorter spur which never exceeds the lower lip in length and the tuberculate or papillose seeds warrant distinct status for U. roseopurpurea.

Certain species were Lecto/Neotypified following the rules in the International Code of Botanical Nomenclature:

U. purpurascens Graham (1839) was validly published on the basis of materials observed in Mahableshwar. John Graham's catalogue, in general, did not deal with dried specimens preserved in a herbarium. In the absence of original materials preserved in any of the herbaria, Janarthanam 82941 (MH) collected from the type locality is designated as neotype of this species.

Gamble (1924) did not designate any type for U. roseo-purpurea Stapf ex Gamble, though he had critically studied and determined several collections from "W. Ghats, Anamalais, Pulneys and hills of Travancore, to 7,000 ft., in swamps." After studying the original materials, the collection C.A. Barber 3982 (Paralai, Anamalais, 7 November 1901, MH acc. no. 36624) is selected as the lectotype of the species.

Oliver (1859), while describing U. brachiata quoted three different collections. They are mounted on the same sheet. Taylor (in Herb. Kew) erroneously pointed out collection number '3' (collected from Lachen, 10-11000 ft., 3.8.1849) as holotype of the species. According to the code this is to be designated 'lectotype' of U. brachiata Oliver.

The protologue of U. furcellata Oliver includes two different collections from Sikkim and Khasia Hills. These collections are mounted on the same sheet. As the protologue best fits the specimens from Khasia hills, they have been designated as lectotype of the species.

As the type specimens of Diurospermum album Edgew. could not be traced, it is concluded that all the original materials used by Edgeworth has presumably been lost or destroyed. The specimens subsequently used by Oliver (Strachey & Winterbottom s.n. collected in Pilti at 7,500' in W. Himalayas-K) best fits the protologue and hence

selected as neotype. Taylor in Herb. Kew has erroneously labelled this material as "Type" of U. kumaonensis Oliver." It is rightly justified that U. kumaonensis was published only as a new name for the replaced synonym Diurospermum album Edgew.

The name U. wightiana M. K. Janarthanam is proposed as an avowed substitute for U. squamosa Wight (1849), non Benj. (1845) and treated distinct.

Distribution of several species has been extended/ altered. Detailed descriptions are given for all the species. Seed characters of taxonomic significance have been reported for the first time for U. multicaulis, U. praeterita and U. furcellata. Many characters hitherto not observed in earlier works, like the number of nerves in foliar organs, structure of traps, size and orientation of spur, presence or absence of thickening along the dehiscent margin of the capsule and position of hilum have proved to be quite diagnostic and hence have been used in the construction of keys to the species.

Pollen morphology has been correlated to taxonomy; the observation of Thanikaimoni (1966) that aquatic, terrestrial and epiphytic Utricularias have three distinct groups of pollen, is confirmed.

Phytogeographical evidences show that all the terrestrial species endemic to Peninsular India have basically 3-nerved foliar organs suggesting that the terrestrial

species with 1-nerved foliar organs might have evolved earlier.

All information contained in this thesis are first-hand and reliable as they are based on the critical study of ample materials and field observations. The thesis which forms the first comprehensive work on the family Lentibulariaceae in India, is respectfully submitted to the Bharathiar University for the award of Ph. D. degree in Botany.

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V INDEX TO COLLECTORS

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The list of collectors is arranged alphabetically. For each collection number the corresponding species number is indicated with the acronyms of herbaria where the specimens are deposited. *Pinguicula alpina* is numbered as 'P' and mixed collections are shown by a '+' mark in between two species numbers. When the collection number/field number is not given on the sheet, the herbarium accession number/serial number is given. If no number is available it is given as 's.n.' with the acronym of the herbarium.

Abraham: 264 = 19 (BLAT); 267 = 6 (CAL); 354 = 19 (BLAT).

Acland: ACK 858 = 27 (BLAT); 859 = 27 (BLAT); 860 = 27 (BLAT); ACK 861 = 32 (BLAT).

Almeida: 408 = 32 (BLAT); 976 = 12 (BLAT); Acc. no. 54100 = 32 (BLAT).

Ambo: 6817 = 32 (BLAT); 6880 = 16 (BLAT); 7277 = 3 (BLAT).

Anderson: Acc.no. 330592 = P (CAL).

Anglade: 1794 = 8 (CAL).

Ansari, M.Y.: 67560 = 1 (BSI); 67637 = 12 (BSI); 67638 = 23 (BSI); 78461 = 27 (BSI); 93837 = 8 (BSI, CAL); 124034 = 12 (BSI).

Ansari, R.: 51470 = 32 (CAL, MH); 64717 = 27 (CAL, MH); 64808 = 3 (CAL, MH); 67929 = 3 (CAL, MH); 74330 = 9 (MH); 74334 = 9 (MH).

Arora: 1477 = 3 (CAL); 38804 = 32 (BSD, CAL); 38818 = 32 (BSD, CAL); 41403 = 32 (BSD, CAL); 45475 = 32 (BSD);

- 45681 = 15 (BSD).
- Arora & Prasad: 56570 = 32 (BSD); 56640 = 26 (BSD).
- Babu: 34088 = 32 (BSD); 34942 = 29 (BSD).
- Bachketi: Acc.no. 140598 = 31 (DD).
- Bal: 247 = 31 (CAL).
- Balakrishnan, C.: Acc.no. 2732 = 31 (LWG).
- Balakrishnan, N.P.: 11347 = 3 (MH); 39323 = 3 (ASSAM, CAL); 46998 = 6 (ASSAM); 50145 = 6 (ASSAM).
- Balakrishnan, N.P. & Henry: 11872 = 10 (MH); 12033 = 12 (CAL, MH).
- Balapur & party: 57528 = 3 (LWG).
- Banerjee: 57 = 3 (CAL).
- Banerji: s.n. = 3 (CAL).
- Barber: 281 = 10 (MH); 2035 = 32 (MH); 2529 = 27 (CAL, MH); 2680 = 29 (CAL, MH); 2936 = 28 (MH); 3073 = 30 (CAL, MH); 3716 = 28 (MH); 3732 = 29 (MH); 3982 = 28 (MH); 4025 = 28 (MH); 5707 = 12 (MH); 6081 = 32 (MH); 6772 = 27 (MH); 7531 = 8 (MH); 8948 = 6 (MH); 8949 = 22 (MH).
- Barnes: Acc.no. 103686 = 30 (DD); Acc.no. 109916 = 32 (DD); s.n. = 8 (DD); s.n. = 30 (DD).
- Beddome: 100 = 8 (CAL); 104 = 6 (CAL); Acc.no. 36580 = 27 (MH).
- Bell: 2518 = 32 (BLAT); 4290 = 34 (BLAT); 5390 = 32 (BLAT).
- Bharadwaja: Acc.no. 8497 = 31 (LWG); Acc.no. 8524 = 3 (LWG); Acc.no. 16530 = 3 (LWG); Acc.no. 111781 = 31 (LWG).

Bhattacharya: 12888 = 10 (BSD); 17958 = 4 (BSD, CAL);
 21417 = 4 (BSD, CAL); 30890 = 26 (BSD); 39263 = 4
 (BSD); 41150 = 4 (BSD); 49276 = 18 (BSD, CAL); 66448
 = P (BSD).

Bhide: 1105 = 12 (BSI).

Billore: 116747 = 32 (BSI).

Biswas, K.: 4243 = 8 (CAL); 4297 = 6 (CAL); 6924 = P
 (CAL).

Biswas, S.N.: 5 = 3 (CAL).

Bl. & Hall: 495 = 29 (BLAT); 22554 = 31 (BLAT).

Bole: PVB 111 = 12 (LWG); BOLE894 = 32 (BLAT).

Bor: 18105 = 3 (DD); 18440 = 26 (DD); Acc.no. 96975 = 8
 (DD).

Bor's collector: 35 = 15 (DD); 676 = 15 (DD); 403 = 26
 (DD).

Bourdillon: 689 = 6 (CAL).

Bourne: 17 = 12 (PCM); 304 = 29 (MH, PCM); 2842 = 32
 (MH); Acc.no. 330219 = 29 (CAL); s.n. = 30 (CAL, MH).

Bournier: 2155 = 6 (CAL); 2158 = 22 (CAL, MH).

Burkill: 27687 = 7 (CAL).

Calder & Ramaswami: 807 = 6 (CAL); 809A = 8 (DD).

Campbell: 334 = 6 (CAL, DD); Acc.no. 330254 = 8 (CAL);
 s.n. = 13 (DD).

Cave: Acc.no. 330232 = 26 (CAL); s.n. = 11 (CAL, DD).

Champion: Acc.no. 63098 = P (DD); Acc.no. 73095 = 26
 (DD).

Chandra & party: 36412 = 6 (LWG); 36415 = 8 (LWG); 44057
 = 32 (LWG).

Chandrabose: 45099 = 6 (MH); 49117 = 8 (CAL, MH).

Chennaveeraiah: Acc.no. 54151 = 1 (BLAT).

Chibber: s.n. = 12 (BSD).

Chowdhery & Singh: 76281 = 32 (BSD).

Clarke: 5796 = 13 (CAL); 10947 = 12 (CAL); 15164 B = 8 (CAL); 15570 = 26 (CAL); 16259 = 13 (CAL); 24884 = 6 (CAL); 33807 A = 8 (DD); 33850 = 8 (CAL); 34395 E = 3 (CAL); 44833 = 13 (CAL); 45063 = 8 (DD); 45291 = 8 (CAL).

Clubber: s.n. = 31 (BSI).

Collett: 40 = 26 (CAL); 120 = P (CAL).

Cooke: 134 = 25 (CAL); s.n. = 12 (BSI); s.n. = 31 (BLAT, BSI, CAL).

Dalzell: Acc. no. 330076 = 1 (CAL); s.n. = 12 (CAL); s.n. = 27 (CAL, DD).

Daniel Sunderaraj: 20403 = 12 (MH); 21390 = 10 (MH).

De & Forst: s.n. = 26 (ASSAM).

Deb: 29332 = 3 (ASSAM); 29336 = 3 (ASSAM); 30377 = 10 (MH); 30937 = 12 (MH); 31294 = 29 (CAL, MH); 31426 = 29 (CAL, MH); 31507 = 12 (MH); 35196 = 3 (ASSAM).

Debberman: 153 = 3 (CAL).

Debberman's collector: 813 = 3 (CAL).

Deka, G.K.: 18537 = 8 (ASSAM); 18537 A = 26 (ASSAM); 21867 = 10 (ASSAM); 35513 = 3 (ASSAM); Acc. no. 21937 = 26 (ASSAM).

Deka, H.: 76949 = 26 (ASSAM); 76953 = 3 (ASSAM); 77232 = 13 (ASSAM).

Dhrume: 29 = 27 (CAL).

Duha: Acc. no. 2334 p.p. = 8 (CAL).

Duthie: 3265 = 26 (CAL, DD); 4266 = 15 (CAL); 4267 = 26 (CAL); 9639 = 3 (CAL, DD); 9640 = 3 (CAL, DD); 10492 = 12 (CAL, DD); 10493 = 29 (CAL, DD).

Ellis: 15772 = 22 (CAL, MH); 16849 = 10 (CAL, MH); 16893 = 22 (CAL, MH); 22128 = 22 (MH); 23759 = 10 (MH); 23788 = 10 (MH); 37886 = 35 (MH).

Fernandez: JF 936 = 12 (BLAT); JF 1177 = 12 (BLAT).

Firashi: 97 = 31 (BLAT).

Fischer: 1421 = 12 (CAL); 2247 = 29 (CAL); 2375 = 12 (CAL); 2513 = 35 (CAL); 2625 = 10 (CAL); 2726 = 29 (CAL); 3222 = 12 (CAL); 3234 = 32 (CAL); 3318 = 12 (CAL); 4019 = 3 (CAL); 4296 = 29 (CAL); 4560 = 27 (CAL); 4685 = 8 (CAL); 4710 = 8 (CAL); 4711 = 29 (CAL); 4712 = 8 (CAL); 4752 = 6 (CAL); Acc. no. 330339 = 32 (CAL); s.n. = 8 (CAL).

Fyson: 3546 = 32 (PCM); 5418 = 32 (PCM); 5571 = 22 (BLAT, PCM); 6506 = 27 (PCM); 6568 = 32 (PCM); 6986 = 29 (PCM).

Gamble: 3291 A = 32 (CAL); 7031 = 3 (CAL, DD); 7408 = 3 (DD); 11356 = 29 (CAL); 12718 = 29 (CAL, DD); 13710 = 3 (CAL); 14705 = 27 (CAL); 21560 = 8 (BSI, DD); 21561 = 22 (BSI, CAL, DD); 21650 = 6 (CAL); 23382 = 32 (CAL).

Gammie: 258 = 26 (CAL); 693 = 15 (CAL, DD); s.n. = 7 (BSI); S.N. = 26 (CAL, DD).

Gangaram: s.n. = 27 (BSI).

Garade: s.n. = 27 (BSI).

Ghosh: 822 = 3 (CAL); 859 = 3 (CAL); 996 = 3 (CAL); 2644 =
3 (CAL); 2664 = 3 (CAL); 2672 = 3 (CAL).

Gibson: Acc. no. 330337 = 32 (CAL).

Gill: Acc. no. 330248 = 8 (CAL).

Goel: 67808 = 26 (BSD).

Govindarajulu: 3768 = 22 (PCM).

Govindarajulu & Swamy: 70 = 32 (PCM); 2364 = 32 (PCM).

Govindu: Acc. no. 96093 = 10 (MH).

Griffith: 4081 = 6 (CAL).

Gupta: Acc. no. 29171 = 10 (BSD).

Haines: 206 = 6 (CAL); 207 = 5 (CAL); 208 = 8 (CAL).

Hajra: 746 = 15 (BSI, Gangtok).

Hall & McCann: 34261 = 27 (BLAT); 34262 = 27 (BLAT);
35186 = 3 (BLAT).

Hari Om Saxena: 2288 = 29 (DD).

Harsukh: 224259 = 4 (CAL, DD).

Helfer: Acc.no. 330087 = 34 (CAL).

Hemadri: 107469 = 25 (BSI).

Henry: ANH 326 = 32 (MH); ANH 1358 = 12 (BLAT); ANH 1609
= 32 (BLAT); 15955 = 31 (MH); 16363 = 12 (CAL, MH);
47144 = 22 (CAL, MH); 47593 = 30 (MH); 48133 = 12
(CAL, MH); 48315 = 30 (MH); 49642 = 32 (CAL, MH);
68804 = 30 (MH); 68866 = 28 (CAL, MH).

Hock: 137 = 3 (CAL).

Hooker: Acc.no. 330366 = 20 (CAL).

Hooker & Thomson: Acc.no. 61486 = 8 (MH); 69357 = 32 (MH); Acc.no. 330166 = 13 (CAL); Acc.no. 330246 = 8 (CAL).

Inayat: 22424 = 3 (CAL, DD).

Indra: 357 = 32 (PCM); 469 A = 6 (PCM).

Irani: 4374 = 32 (BLAT); 4375 = 32 (BLAT); NI 5182 = 32 (BLAT); NI 5412 = 32 (BLAT).

Jacob: 17647 = 32 (MH).

Jameson: s.n. = 3 (DD).

Janardhanan, K.P.: 81733 = 23 (BSI).

Janarthanam, M.K.: 82901 = 32 (MH); 82902 = 12 (MH);
 82903 = 12 (MH); 82904 = 34 (MH); 82905 = 34 (MH);
 82906 = 12 (MH); 82907 = 12 (MH); 82908 = 12 (MH);
 82909 = 12 (MH); 82910 = 12 (MH); 82911 = 12 (MH);
 82912 = 16 (MH); 82913 = 9 (MH); 82914 = 16 (MH);
 82915 = 27 (MH); 82916 = 16 (MH); 82917 = 8 (MH);
 82918 = 16 (MH); 82919 = 8 (MH); 82920 = 9 (MH);
 82921 = 9 (MH); 82922 = 16 (MH); 82923 = 8 (MH);
 82924 = 17 (CAL, MH); 82925 = 32 (MH); 82926 = 9 (MH);
 82927 = 16 (MH); 82928 = 32 (MH); 82929 = 3 (MH);
 82930 = 10 (MH); 82931 = 27 (MH); 82932 = 34 (MH);
 82933 = 8 (MH); 82934 = 19 (MH); 82935 = 27 (MH);
 82936 = 8 (MH); 82937 = 34 (MH); 82938 = 27 (MH);
 82939 = 19 (MH); 82940 = 16 (MH); 82941 = 25 (MH);
 82942 = 1 (MH); 82943 = 23 (MH); 82944 = 25

(MH); 82945 = 1 (MH); 82946 = 1 (MH); 82947 = 23
 (MH); 82948 = 12 (MH); 82949 = 12 (MH); 82950 = 23
 (MH); 82951 = 25 (MH); 82952 = 23 (MH); 82953 = 25
 (MH); 82954 = 23 (MH); 82955 = 32 (MH); 82956 = 25
 (MH); 82957 = 23 (MH); 82958 = 27 (MH); 82959 = 32
 (MH); 82960 = 23 (MH); 82961 = 21 (MH); 82962 = 21
 (MH); 82963 = 21 (MH); 82964 = 28 (MH); 82965 = 34
 (MH); 82969 = 21 (MH); 82973 = 22 (MH); 82974 = 8
 (MH); 82975 = 8 (MH); 82976 = 22 (MH); 82977 = 13
 (MH); 82978 = 8 (MH); 82979 = 10 (MH); 82983 = 10
 (MH); 82984 = 3 (MH); 83005 = 29 (MH); 83028 = 10
 (MH); 83029 = 11 (MH); 83030 = 26 (MH); 83031 = 8
 (MH); 83032 = 26 (CAL, MH); 83033 = 8 (MH); 83034 =
 26 (MH); 83050 = 21 (MH); 83051 = 21 (MH); 83052 = 21
 (MH); 83053 = 21 (MH).

John Cherian: 106082 = 8 (BSI); 106117 = 8 (BSI, CAL);
 106125 = 27 (BSI, CAL); 106663 = 27 (BSI, CAL).

Johnson: Acc. no. 330343 = 32 (CAL); 330344 = 32 (CAL).

Joseph, J.: 13303 = 32 (MH); 13552 = 28 (CAL) + 12
 (MH); 13565 = 12 (CAL) + 28 (MH); 13581 = 29 (MH);
 15558 = 12 (CAL, MH); 15564 = 3 (CAL, MH); 15858 = 34
 (MH); 16218 = 12 (MH); 17595 = 27 (MH); 17766 = 3
 (CAL, MH); 40083 = 26 (ASSAM); 41977 = 32 (MH); 44432
 = 8 (MH); 44463 = 27 (MH); 44629 = 28 (MH); 44645 =
 29 (MH); 44649 = 22 (MH); 50993 = 33 (ASSAM); 51443 =
 32 (CAL, MH); 76932 = 11 (ASSAM); 76941 = 26 (ASSAM);

76945 = 10 (ASSAM); 76947 = 6 (ASSAM).

Joseph, K.M.: 79366 = 10 (ASSAM).

Kamath: 341 = 27 (PCM); 485 = 32 (PCM); 702 = 22 (PCM);
718 = 6 (PCM).

Kanodia: 88375 = 27 (BSI); 89401 = 23 (BSI); 89429 = 27
(BSI, CAL); 89507 = 16 (BSI).

Kapadia: 236 = 31 (BLAT); 292 = 31 (BLAT).

Kapoor & party: 64584 = 29 (LWG); 64965 = 3 (LWG); 69850
= 3 (LWG); 71706 = 8 (LWG); 75453 = 26 (LWG).

Karthikeyan & Chandrabose: 31816 = 12 (CAL, MH).

Kaul & party: 5001 = 31 (LWG); 17750 = 31 (LWG).

King: 12 = 4 (CAL); 35 = 4 (CAL); 36 = 10 (CAL); 96 = 8
(CAL); Acc. no. 33007 = 4 (CAL); 330281 = 8 (CAL);
330340 = 32 (CAL); s.n. = 32 (CAL).

King's collector: Acc. no. 330598 = P (CAL).

Kingdon-Wards: 18 = 26 (CAL); 22 = 32 (CAL); 19568 = P
(ASSAM).

Kulkarni: 106430 = 27 (BSI); 107610 = 27 (BSI); 119042 =
27 (BSI); 121379 = 27 (BSI); 131657 = 8 (BSI).

Kurz: 155 = 6 (CAL); Acc. no. 329967 = 31 (CAL); Acc. no.
330022 = 3 (CAL); Acc. no. 330056 = 10 (CAL); Acc.
no. 330065 = 10 (CAL); Acc. no. 330160 = 5 (CAL);
Acc. no. 330186 = 6 (CAL); Acc. no. 330282 = 8 (CAL).

Lawson: Acc. no. 330078 = 1 (CAL); Acc. no. 36526 = 3
(MH); Acc. no. 36578 = 27 (MH); Acc. no. 36650 = 27
(MH); Acc. no. 36652 = 22 (MH).

Lowndeo: 726 = 32 (CAL).

Mahajan: 24743 = 12 (BSI).

Majumdar: 303 = 26 (CAL).

Malhothra: 13356 = 31 (BSD); 19578 = 3 (BSD); 21438 = 4 (BSD); 21466 = 3 (BSD); 23693 = 10 (BSD, CAL); 42397 = 3 (BSD, CAL).

Marten: s.n. = 12 (DD).

Masters: s.n. = 6 (CAL).

Meebold: 470 = 3 (CAL); 6830 = 32 (CAL); 9795 = 8 (CAL); 9797 = 34 (CAL); 9800 = 27 (CAL); 10328 = 29 (CAL); 10329 = 12 (CAL); 13517 = 28 (CAL).

Merchant: 185 = 32 (BLAT).

Misra: 9733 = 8 (CAL); 41743 = 31 (BSD, CAL).

Mohanan, C. N.: 58339 = 27 (MH); 58340 = 8 (MH); 58341 = 6 (MH); 58342 = 14 (CAL, MH); 63705 = 8 (MH).

Mohanan, M.: 54705 = 27 (CAL, MH); 58509 = 32 (CAL); 58519 = 34 (CAL, MH); 59430 = 10 (CAL, MH).

Mokim: Acc. no. 330044 = 3 (CAL).

Mooney: 1277 = 8 (DD); 1462 = 12 (DD); 1463 = 6 (DD); 1519 = 8 (DD); 1644 = 8 (DD); 1645 = 13 (DD); 2219 = 3 (DD); 2766 = 32 (DD); 2865 = 6 (DD); 3689 = 8 (DD).

Moses Ezekiel: 54067 = 31 (BLAT); 54068 = 31 (BLAT).

Mukerjee: 6056 = 6 (CAL).

Murti & Prasad: 62057 = 32 (BSD).

Nafday: 59 = 8 (BSI, CAL); 81 = 3 (BSI, CAL).

Nair, N.C.: 18973 = 31 (BSD, CAL); 18975 = 31 (BSD, CAL);

18995 = 31 (BSD); 24725 = 31 (BSD); 35926 = 32 (BSD, CAL); 36206 = 4 (BSD); 50733 = 32 (CAL, MH); 50871 = 32 (CAL, MH); 64260 = 32 (MH); 64421 = 34 (MH); 64521 = 32 (CAL, MH); 69170 = 12 (MH); 69564 = 12 (MH); 69649 = 12 (MH).

Nair, V.J.: 37660 = 31 (BSD, CAL); 59977 = 3 (CAL, MH); 67268 = 12 (CAL, MH); 67407 = 12 (CAL, MH).

Naithani: 221 = 29 (DD); 3158 = 3 (DD); 42017 = 32 (BSD, CAL).

Nana: 5532 = 12 (CAL).

Narayana: Acc. no. 81951 = 31 (MH).

Narayananaswamy: Acc. no. 80758 = 22 (MH).

Naskar: s.n. = 3 (CAL).

Nusker: 3 = 10 (CAL).

Pallithanam: 3291 = 29 (BLAT).

Pandey: Acc. no. 62067 = 4 (LWG).

Panigrahi: 1125 = 12 (CAL); 2827 = 10 (CAL); 2922 = 8 (CAL); 3516 = 8 (CAL); 3517 = 26 (CAL); 3678 = 31 (CAL); 4195 = 26 (CAL); 4501 = 3 (ASSAM); 4741 = 11 (ASSAM); 13043 = 3 (CAL); 18969 = 3 (ASSAM); 19848 = 26 (ASSAM); 20560 = 3 (ASSAM, CAL); 23749 = 3 (CAL); 23753 = 10 (ASSAM).

Panigrahi & Arora: 8685 = 10 (CAL).

Panigrahi & Wadhwa: 65189 = 32 (BSD).

Pant & Naithani: 38567 = 32 (BSD); 39559 = 32 (BSD); 39773 = 15 (BSD).

Pantling: Acc. no. 330599 = P (CAL); Acc. no. 330600 = P (CAL); Acc. no. 330601 = P (CAL).

Paranjpe: s.n. = 31 (BSI).

Parthasarathy: 434 = 12 (MH); 494 = 34 (MH).

Periyasamy: 29395 = 32 (MH).

Prabhat Hazra: 139 = 22 (CAL).

Prain: Acc. no. 330118 = 12 (CAL); Acc. no. 330150 = 22 (CAL); Acc. no. 330190 = 6 (CAL); Acc. no. 330252 = 8 (CAL); Acc. no. 330280 = 8 (CAL); Acc. no. 330347 = 32 (CAL); Acc. no. 330348 = 32 (CAL); Acc. no. 330349 = 32 (CAL); s.n. = 26 (CAL).

Prakash: KFP 8318 = 10 (CAL).

Pullaiah: 926 = 10 (MH); 952 = 22 (MH); 953 = 29 (MH).

Raghavan: 68169 = 8 (BSI); 90004 = 27 (BSI); 90300 = 32 (BSI).

Raizada: 5501 = 32 (DD).

Rajasekhara Mudaliar: Acc. no. 93839 = 3 (MH).

Ramachandran: 52197 = 27 (CAL, MH); 54038 = 27 (CAL, MH); 54103 = 27 (CAL, MH); 61906 = 27 (CAL, MH); 62169 = 34 (MH); 65204 = 27 (CAL, MH).

Ramamurthy: 14865 = 13 (MH); 18102 = 12 (MH); 22730 = 22 (MH); 22731 = 6 (MH); 22732 = 8 (MH); 22733 = 8 (CAL, MH); 23375 = 35 (MH); 23445 = 29 (MH); 25942 = 13 (MH); 25943 = 19 (MH); 25944 = 8 (MH); 47656 = 3 (MH); 48490 = 8 (CAL, MH); 48492 = 32 (CAL, MH); 48532 = 27 (CAL, MH); 51125 = 3 (CAL); 52866 = 22

(CAL, MH); 53607 = 31 (CAL, MH); 53737 = 8 (MH);
 53743 = 22 (CAL, MH); 60251 = 22 (CAL, MH); 64106 =
 31 (CAL, MH); 74716 = 3 (MH); 74935 = 3 (MH); 75551 =
 3 (MH); 80433 = 3 (MH).

Rama Rao: 1060 = 27 (DD); 2205 = 27 (CAL).

Rama Rao's collector: 1976 = 12 (CAL); 2257 = 3 (CAL).

Rama Rao & Venkoba Rao: 2244 = 8 (CAL).

Ramaswami: 212 = 3 (CAL).

Ram Dayal: 21769 = 10 (DD).

Ramesh & Prakash: KFP 3158 = 27 (CAL).

Randeria: AR 365 = 32 (BLAT); AR 548 = 31 (BLAT); AR 557
 = 31 (BLAT); AR 558 = 32 (BLAT).

Rao, A.S.: 42480 = 3 (ASSAM); 45172 = 24 (ASSAM); 53707 =
 29 (BSD); 53721 = 24 (BSD); 53722 = 29 (BSD); 80284 =
 10 (BSI, CAL); 80285 = 4 (BSI); 80402 = 12 (CAL).

Rao, A.V.N.: 18266 = 29 (CAL, MH); 26953 = 29 (MH); 27499
 = 8 (CAL, MH).

Rao, G.V.S.: 30146 = 3 (ASSAM); 30342 = 8 (ASSAM).

Rao, R.S.: 81399 = 32 (BSI); 84421 = 27 (BSI, CAL).

Rao, T.A.: E 4110 = 3 (CAL); E 5633 = 31 (CAL); 5697 =
 22 (CAL); 6935 = P (BSD); 7100 = P (BSD); 9380 = 4
 (BSD, CAL); 10985 = 4 (CAL).

Rau, M.A.: 2910 = P (BSD); 6452 p.p. = 32 (BSD); 6457 =
 26 (BSD); 10419 = 32 (BSD).

Ribu & Rhomoo: 3673 = 3 (CAL); 3694 = 3 (CAL).

Saldanha: CS 1336 = 32 (BLAT); CS 1531 = 1 (BLAT); CS
 1621 = 25 (BLAT); CS 1623 = 25 (BLAT); CS 1624 = 25

(BLAT); CS 4247 = 21 (BLAT); CS 5728 = 32 (BLAT); CS 7179 = 32 (BLAT); CS 7245 = 27 (BLAT); CS 7281 = 3 (BLAT); CS 7513 = 8 (BLAT); CS 8045 = 28 (BLAT).

Saldanha & Keshavamurthy: KFP 3385 = 12 (CAL).

Saldanha, Ramesh & Ravindra: KFP 1980 = 32 (CAL); KFP 1993 = 27 (CAL).

Saldanha & Sreenath: KFP 4850 = 10 (CAL).

Santapau: 151.1/482 A = 32 (BLAT); 151.2/500 A = 25 (BLAT); 151.5/573(2) A = 25 (BLAT); 736 = 25 (BLAT); 829 = 32 (BLAT); 836 = 32 (BLAT); 924 = 25 (BLAT, DD); 1518 = 31 (BLAT); 1519 = 31 (BLAT); 2473(2) = 32 (BLAT); 2815 = 25 (BLAT); 4735 = 32 (BLAT); 4815 = 32 (BLAT); 4856 = 25 (BLAT); 5039 = 25 (BLAT); 6862 = 32 (BLAT); 9641 = 27 (BLAT); 10267 = 25 (BLAT); 10908 = 12 (BLAT); 11688 = 25 (BLAT); 12941 = 32 (BLAT); 13291 = 32 (BLAT); 13345 = 25 (BLAT); 13346 = 27 (BLAT); 15019 = 32 (BLAT); 15020 = 32 (BLAT); 15810 = 32 (BLAT); 15846 = 32 (BLAT); 16068 = 31 (BLAT); 16069 = 31 (BLAT); 16070 = 31 (BLAT); 17772 = 12 (BLAT); 18983 = 25 (BLAT); 18984 = 25 (BLAT); 18985 = 32 (BLAT); 19405 = 32 (BLAT); 20103 = 25 (BLAT); 20220 = 32 (BLAT); 20221 = 32 (BLAT); 20222 = 32 (BLAT); 21143 = 25 (BLAT); 21144 = 25 (BLAT); 21145 = 32 (BLAT); 21182 = 25 (BLAT); Acc. no. 54018 = 3 (BLAT); Acc. no. 91061 = 3 (DD).

Sanyal: 299 = 3 (CAL); 580 = 10 (CAL); 1418 = 31 (CAL).

Saran & party: 2650 = 4 (LWG); 37873 = 31 (LWG); 58121 = 3 (LWG).

Saxena: 1374 = 32 (DD); 2196 = 32 (DD); 2327 = 24 (DD);
2327 A = 24 (DD); 2327 B = 19 (DD).

Sebastine: 2705 = 12 (CAL, MH); 5503 = 3 (MH); 8899 = 8
(MH); 8921 = 31 (CAL, MH); 9686 = 29 (MH); 17298 = 32
(CAL, MH); 17542 = 28 (CAL, MH); 17543 = 21 (CAL,
MH); 17544 = 32 (CAL, MH); 17545 = 21 (CAL, MH);
26667 = 27 (MH); 26741 = 3 (CAL, MH).

Sedgwick: 1931 = 31 (BLAT, PCM); 2317 = 31 (BLAT, PCM);
3270 = 12 (CAL, PCM); 3271 = 27 (CAL, PCM); 4457 = 10
(BLAT); 4538 = 32 (BLAT); 5034 = 27 (BLAT); 7936 = 27
(BLAT).

Seshagiri Rao: 84947 = 27 (BSI, CAL).

Seshagiri Rao Rolla: 73440 = 8 (BSI).

Shah: 6564 = 31 (BLAT); 6566 = 31 (BLAT); Shah 6612 = 27
(BLAT); Shah 6613 = 27 (BLAT); Shah 8128 = 31 (BLAT);
9390 = 27 (BLAT).

Shaik Mokim: Acc. no. 330023 = 3 (CAL).

Sharma, B.D.: 36043 = 29 (MH); 36083 = 12 (MH); 39974 =
12 (MH); 40354 = 12 (MH); 40835 = 34 (MH); 40850 = 32
(MH).

Sharma, J.P.: 70302 = 3 (BSD).

Shenoy: KVS 812 = 31 (BLAT); KVS 957 = 31 (BLAT); KVS
1256 = 27 (BLAT); KVS 1264 = 27 (BLAT).

Shetty: 63 = 3 (CAL); 73 = 31 (CAL); 6755 = 4 (BSJO);
26486 = 28 (CAL, MH); 32355 = 32 (MH); 32949 = 32
(CAL, MH); 33005 = 12 (CAL, MH); 33014 = 29 (MH);
33050 = 28 (CAL, MH).

Shukla: 70245 = 3 (BSD).

Singh, A. & party: 54735 = 10 (LWG); 56040 = 3 (LWG);
56052 = 10 (LWG).

Singh, A.N.: 6084 = 31 (BSJO, CAL).

Singh, N.P. : 25388 = 31 (BSD, LWG); 25389 = 3 (BSD, CAL,
LWG); 124274 = 8 (BSI); 124356 = 8 (BSI).

Singh, N.P. & C.L. Malhotra: 10957 = 3 (BSD, CAL).

Singh, V.: 3 = 3 (CAL); 3709 = 31 (BSJO, CAL).

s.l.: 2373 = 10 (BLAT); 2743 = 25 (BLAT); 9340 = 27 (MH);
10882 = 34 (MH); 11959 = 10 (MH); 11974 = 27 (MH);
12717 = 31 (MH); 12818 = 27 (MH); 13151 = 32 (MH);
13973 = 29 (MH); 22786 = 10 (BLAT); 22789 = 3 (BLAT);
27562 = 27 (BLAT); 27563 = 27 (BLAT); 27564 = 27
(BLAT); 27565 = 27 (BLAT); 27566 = 27 (BLAT); 36566 =
35 (MH).

Smith: 4113 = P (CAL).

Smith & Cave: 1733 = 7 (DD); 1973 = P (CAL); 2391 = 20
(CAL).

Sreemadhavan: CPS 311 = 29 (MH).

Srinivasan: 68043 = 34 (MH).

Srivastava: 99112 = 3 (LWG).

Srivastava & party: 79945 = 3 (LWG).

Stewart: 14584 = 32 (DD).

Stocks & Law: Acc. no. 36521 = 31 (MH); Acc. no. 36632 =
32 (MH); Acc. no. 36582 = 27 (MH); Acc. no. 330077 =
1 (CAL).

Subba Rao: 22606 = 29 (MH); 22611 = 12 (MH); 22612 = 12
(MH); 32023 = 22 (CAL, MH); 32025 = 29 (MH); 36573 =
12 (MH); 36610 = 29 (MH); 36663 = 12 (MH); 40483 = 12

(MH); 40536 = 29 (MH); 42621 = 8 (MH); 42625 = 6

(MH); 45935 = 8 (MH); 45938 = 6 (MH).

Subramanian, K.N.: 70691 = 27 (BSI); 70793 = 27 (BSI);

77061 = 10 (BSI); 77380 = 29 (BSI).

Subramanyam, K.: 1099 = 12 (CAL, MH); 2385 = 12 (CAL,

MH); 4649 = 3 (MH); 4682 = 8 (MH); 4683 = 8 (MH);

4931 = 32 (MH); 4944 = 12 (CAL, MH); 5035 = 19 (MH);

5061 = 31 (MH); 5073 = 3 (MH); 5410 = 27 (CAL, MH);

6595 = 29 (MH); 6947 = 32 (CAL, MH); 7148 = 3 (CAL,

MH); 7162 = 8 (MH); 7211 = 6 (CAL, MH); 7779 = 10

(CAL, MH); 9455 = 32 (CAL, MH).

Suman Chopra: 78105 = 26 (LVG).

Sundararaghavan: 67827 = 27 (BSI); 68102 = 29 (BSI);

68170 = 27 (BSI); 82753 = 27 (BSI); 82904 = 12 (BSI);

83273 = 8 (BSI); 86018 = 27 (BSI); 86068 = 12 (BSI);

90356 = 8 (BSI).

Talbot: 142 = 27 (CAL); 1046 = 34 (BSI, CAL); 1047 = 8

(CAL); 1284 = 34 (DD); 1579 = 16 (CAL); 1581 = 12

(BSI); 1582 = 12 (DD); 3230 = 27 (BSI, DD); 3760 = 25

(CAL); 4017 = 12 (BSI); Acc. no. 6957 = 27 (BSI);

Acc. no. 6959 = 3 (BSI); Acc. no. 6964 = 27 (BSI);

Acc. no. 6965 = 27 (BSI); 6966 = 12 (BSI).

Thomson: Acc. no. 69354 = 10 (MH); Acc. no. 330012 = 3

(CAL).

Thothathri: 10093 = 10 (CAL).

Townsend: s.n. = P (CAL).

Umashankar Misra: Acc. no. 247 = 31 (LVG).

Vaid: M-140 = 32 (DD).

Vajravelu: 19132 = 34 (MH); 26236 = 32 (CAL, MH); 29126 = 12 (MH); 35006 = 12 (MH); 39650 = 29 (MH); 39678 = 34 (MH); 44791 = 34 (MH); 44810 = 3 (MH); 48708 = 32 (CAL, MH); 48751 = 12 (CAL, MH).

Vasudevan Nair: s.n. = 19 (MH).

Venkata Reddi: 98642 = 32 (BSI); 100946 = 10 (BSI).

Verma: 215 = 31 (CAL); 46463 = 3 (ASSAM).

Vicary: Acc. no. 330055 = 10 (CAL); 329968 = 31 (CAL);
Acc. no. 330249 = 8 (CAL); 330277 = 8 (CAL).

Viswanathan: MVV 556 = 29 (MH).

Vivekananthan: 21430 = 32 (MH); 46573 = 30 (MH); 46730 = 34 (MH); 46749 = 32 (CAL, MH); 48346 = 34 (MH); 50509 = 32 (CAL, MH).

Wadhwa: 59471 = 18 (BSD); 57634 = 32 (BSD); 109669 = 12 (BSI); 127776 = 32 (BSI); 133536 = 6 (BSI).

Wagh: SKW 7201 = 22 (BLAT); 7202 = 22 (BLAT); 7203 = 22 (BLAT).

Watt: 7457 = 3 (CAL).

Wight: 2414 = 27 (CAL, MH); 2417 = 12 (CAL); 2419 = 10 (CAL); 2421 = 3 (CAL, MH); Acc. no. 330140 = 27 (CAL).

Younghusband: 1383 = 26 (DD).

Yuvaraj K. Sarin: 5195 = 3 (BSD).

VI INDEX TO GENERA, SPECIES AND INFRA-SPECIFIC TAXA

VI. INDEX TO GENERA, SPECIES AND INFRA-SPECIFIC TAXA

The correct names are given in bold face and synonyms
single underlined.

Biovularia Kamienski 8

Cosmiza Raf. 7

Diurospermum Edgew. 11, 55

D. album Edgew. 11, 55, 122, 123, 124, 125, 205, 206

Genlisea St. Hil. 1, 7, 8, 50

Lentibularia Seguiet 49, 55

Meloneura Raf. 7, 55

M. purpurea Raf. 55, 182

M. striatula (Smith) Barnh. 182

Pinguicula L. 1, 5, 7, 8, 9, 10, 12, 19, 28, 29, 37, 44, 50,
51, 149, 202

P. alpina L. 7, 11, 19, 20, 27, 28, 30, 33, 35, 37, 40,
44, 52, 53

P. vulgaris L. 51

Polypompholyx Lehm. 1, 7, 8, 9, 50

Stomoisia Raf. 7

Utricularia L. 1, 5, 7, 8, 9, 10, 11, 12, 18, 19, 20, 23,
27, 28, 29, 30, 32, 37, 41, 42, 44, 45,
48, 49, 50, 51, 54, 124, 139, 159, 202

U. affinis Wight 8, 11, 193

var. griffithii (Wight) Oliver 194

U. alata Benj. 11, 200

U. alba Hoffmannsegg ex Ling 123, 124

U. albocaerulea Dalzell 11, 21, 23, 26, 28, 31, 33,
34, 38, 44, 60, 63, 65, 66, 128, 152, 203

U. arcuata Wight 11, 65, 149, 152

U. arenaria A. DC. 13, 21, 23, 24, 26, 33, 35, 44, 61, 66

U. aurea Lour. 7, 8, 19, 20, 22, 24, 25, 27, 28, 29,
30, 31, 32, 33, 36, 39, 40, 42, 44, 57,
58, 68, 72, 78, 104

U. australis R. Br. 13, 19, 20, 22, 25, 27, 35, 36,
37, 44, 57, 69, 72, 77, 78, 132,

U. baouleensis A. Chev. 21, 23, 24, 26, 27, 28, 31, 32,
36, 39, 44, 46, 47, 57, 60, 80, 82

U. bifida L. 8, 10, 21, 23, 26, 28, 31, 32, 35, 36, 44,
47, 61, 82, 85, 120, 122, 142, 200, 203

U. biflora Roxb. 101

U. brachiata Oliver 11, 20, 22, 25, 31, 32, 34, 38, 39,
44, 46, 59, 87, 88, 89, 184, 205

U. brachypoda Wight 11, 193

U. caerulea 111, 157, 174

var. *graminifolia* (Vahl) Bhattacharyya 90, 111, 157

var. *smithiana* (Wight) Clarke 173

var. *squamosa* (Wight) Clarke 198

U. caerulea L. 8, 9, 10, 21, 23, 24, 26, 27, 28, 29, 30,
33, 35, 36, 39, 40, 44, 46, 57, 59, 89,
93, 94, 160, 166, 199, 203, 204

var. *filicaulis* (Wall. ex Walp.) Gamble 91

U. capillacea Vahl 118

U. capillacea Wall. ex Oliver 133

U. capillacea Willd. 10, 200

U. cecilii Taylor 13, 21, 23, 26, 31, 33, 34, 38, 44,
62, 65, 98, 99, 100

U. conferta Wight 11, 111

U. confervifolia Jacks ex D. Don 70

U. decipiens Dalzell 11, 193

U. diantha Roxb. ex Roem. & Schultes 101

U. diflora Roxb. ex Clarke 10, 101

U. elegans Wall. ex Oliver 102

U. equiseticaulis Blatter & Mc Cann 12, 111, 113

U. exoleta R. Br. 7, 8, 19, 20, 22, 25, 30, 31, 32, 34,
36, 37, 42, 44, 57, 100, 104, 105, 185, 203

U. fasciculata Roxb. 7, 10, 69

U. filicaulis Wall. ex A. DC. 91

U. firmula Welw. ex Oliver 153

U. flexuosa 77

U. flexuosa Vahl 8, 10, 69

U. foveolata Edgew. 11, 200

U. furcellata Oliver 11, 19, 22, 25, 31, 32, 34, 38,
39, 44, 46, 58, 107, 109, 184, 205, 206

var. minor Clarke 107

U. gibba L.

subsp. exoleta (R. Br.) Taylor 102

U. glochidiata Wight 11, 182

U. graminifolia 157, 173, 198

U. graminifolia Vahl 10, 21, 23, 24, 26, 30, 33, 34, 37,
38, 44, 47, 61, 93, 110, 113, 139, 174,
195, 202

U. griffithii Wight 193

U. hirta Klein ex Link 10, 21, 23, 25, 26, 27, 28, 29,
31, 33, 35, 36, 44, 47, 61, 117, 119,
120, 135, 204

U. humilis 141

U. humilis Vahl 10, 83

U. inflexa Forssk. 179, 200

var. *stellaris* (L.f.) Taylor 39, 176

U. keralensis M.K. Janarthanam 29, 31, 33, 38, 44, 61,
120, 122, 203

U. khasiana Joseph & Mani 13, 102, 104, 203

U. kumaonensis Oliver 12, 22, 25, 30, 31, 32, 34, 38,
39, 44, 46, 55, 58, 88, 122, 124, 125,
137, 184, 204, 206

U. lazulina Taylor 13, 21, 23, 26, 31, 33, 34, 38, 44,
62, 126, 128, 130, 202

U. lilliput Pellegrin 13, 133

U. macrocarpa Wall. ex Clarke 176

U. macrolepis Wight 11, 168

U. malabarica M.K. Janarthanam & A.N. Henry 21, 23, 26,
28, 29, 33, 34, 38, 44, 61, 128, 130, 202

U. minor L. 19, 20, 21, 22, 25, 27, 29, 30, 31, 32, 34,
35, 36, 37, 40, 42, 44, 57, 104, 131, 132

U. minutissima Vahl 13, 21, 23, 25, 26, 28, 29, 31,
33, 35, 36, 37, 39, 44, 47, 57, 62, 68,
119, 133, 135, 200

U. muelleri Kamienski 176

U. multicaulis 123

U. multicaulis Oliver 11, 22, 25, 28, 30, 31, 32, 34,
38, 39, 44, 46, 58, 124, 125, 136, 137,
184, 204, 206

U. nayarii M.K. Janarthanam & A.N. Henry 13, 21, 23,
26, 28, 31, 33, 34, 38, 44, 62, 138, 139,
202

U. nivea Vahl 90

U. ogmosperma Blatter & McCann 13, 63, 65, 66, 203

U. orbiculata Wall. ex A. DC. 8, 109, 182

U. paucifolia Benj. 11, 91

U. pedicellata Wight 11, 111

U. polygaloides Edgew. 11, 21, 23, 26, 31, 32, 34, 37,
38, 39, 44, 47, 57, 60, 140, 142

U. praeterita Taylor 13, 21, 23, 26, 31, 33, 34, 38,
44, 62, 144, 146, 196, 206

U. pterosperma Edgew. 11, 101

U. pubescens Smith 13, 21, 23, 24, 26, 27, 33, 35, 36,
44, 59, 147, 148

U. purpurascens Graham 11, 21, 23, 26, 28, 29, 31, 33,
38, 44, 60, 65, 66, 110, 146, 149, 151,
152, 204

U. purpurea Willd. ex Benj. 91

U. pusilla Graham 11, 182

U. racemosa 164

U. racemosa Wall. ex Walp. 8, 40, 90

var. filicaulis (Wall. ex A. DC.) Clarke 91

U. ramosa Vahl 10, 69, 83

U. recta M.K. Janarthanam 21, 23, 24, 26, 28, 33, 38,
39, 40, 44, 47, 57, 60, 85, 153, 155, 203

U. reticulata Smith 9, 21, 23, 26, 27, 31, 32, 34, 37,
38, 44, 47, 60, 65, 82, 93, 99, 143, 156,
159, 160

var. parviflora Santapau 13, 157, 160, 204

var. stricticaulis Koenig ex Oliver 12, 140, 141, 157

var. uliginosa Clarke 140

U. rosea 163

U. rosea Edgew. 11, 165

U. roseopurpurea Stapf ex Gamble 12, 21, 23, 24, 26,
27, 28, 30, 31, 32, 34, 37, 38, 44, 46,
59, 90, 163, 165, 166, 204, 205

U. roxburghii Spreng. 101

U. saharunporensis Royle ex Oliver 102

U. sampathii Subramanyam & Yoganarasimhan 13, 91, 94, 203

U. scandens Benj. 11, 21, 23, 24, 26, 27, 33, 35, 36,
39, 40, 44, 47, 57, 60, 153, 155, 167,
170, 203

subsp. scandens

var. firmula (Oliver) Subramanyam & Banerjee 40,
153, 170

U. scandens Oliver 11, 80, 82

U. setacea Wall. ex Oliver 118

U. smithiana Wight 11, 21, 23, 26, 30, 31, 33, 34, 38,
44, 62, 172, 174

U. squamosa Benj. 11, 91, 199

U. squamosa Wight 11, 197, 199, 206

U. stanfieldii 191

U. stanfieldii Taylor 13, 192, 200, 201

U. stellaris 70

U. stellaris L.f. 7, 8, 10, 20, 22, 25, 27, 28, 29,
30, 31, 32, 36, 37, 39, 42, 44, 57, 72,
175, 178, 200

var. *coromandeliana* A. DC. 176

var. *inflexa* (Forsk.) Clarke 175

U. striatula Smith 8, 22, 25, 31, 32, 34, 36, 37, 39,
44, 46, 55, 58, 109, 181, 184

U. stricticaulis (Koenig ex Oliver) Stapf ex Gamble 12,
39, 140

U. subulata L. 21, 23, 25, 26, 27, 28, 30, 33, 35, 36,
40, 44, 46, 59, 190, 192, 201, 203

U. tayloriana Joseph & Mani 13, 118, 120, 204

U. uliginoides Wight 11, 111

U. uliginosa 157

U. uliginosa Vahl 8, 10, 21, 23, 26, 30, 31, 33, 34,
36, 37, 44, 47, 62, 99, 140, 146, 152,
192, 194, 196

U. uniflora R. Br. 56

U. volubilis Wight ex Benj. 167

U. vulgaris 77

U. vulgaris L. 55, 69

U. wallichiana Wight 11, 168

var. firmula Oliver 12, 153, 168, 203

var. macrolepis (Wight) Gamble 168

U. wallichii Wight 168

U. wightiana M.K. Janarthanam 21, 23, 26, 30, 31, 33,
34, 38, 44, 61, 197, 206

Vesiculina Raf. 7

APPENDIX : REPRINTS OF PUBLICATIONS

A NEW UTRICULARIA L. (LENTIBULARIACEAE) FROM KERALA, INDIA

M.K. JANARTHANAM AND A.N. HENRY

Botanical Survey of India, Coimbatore

ABSTRACT

A new species *utricularia nayarii* has been described.

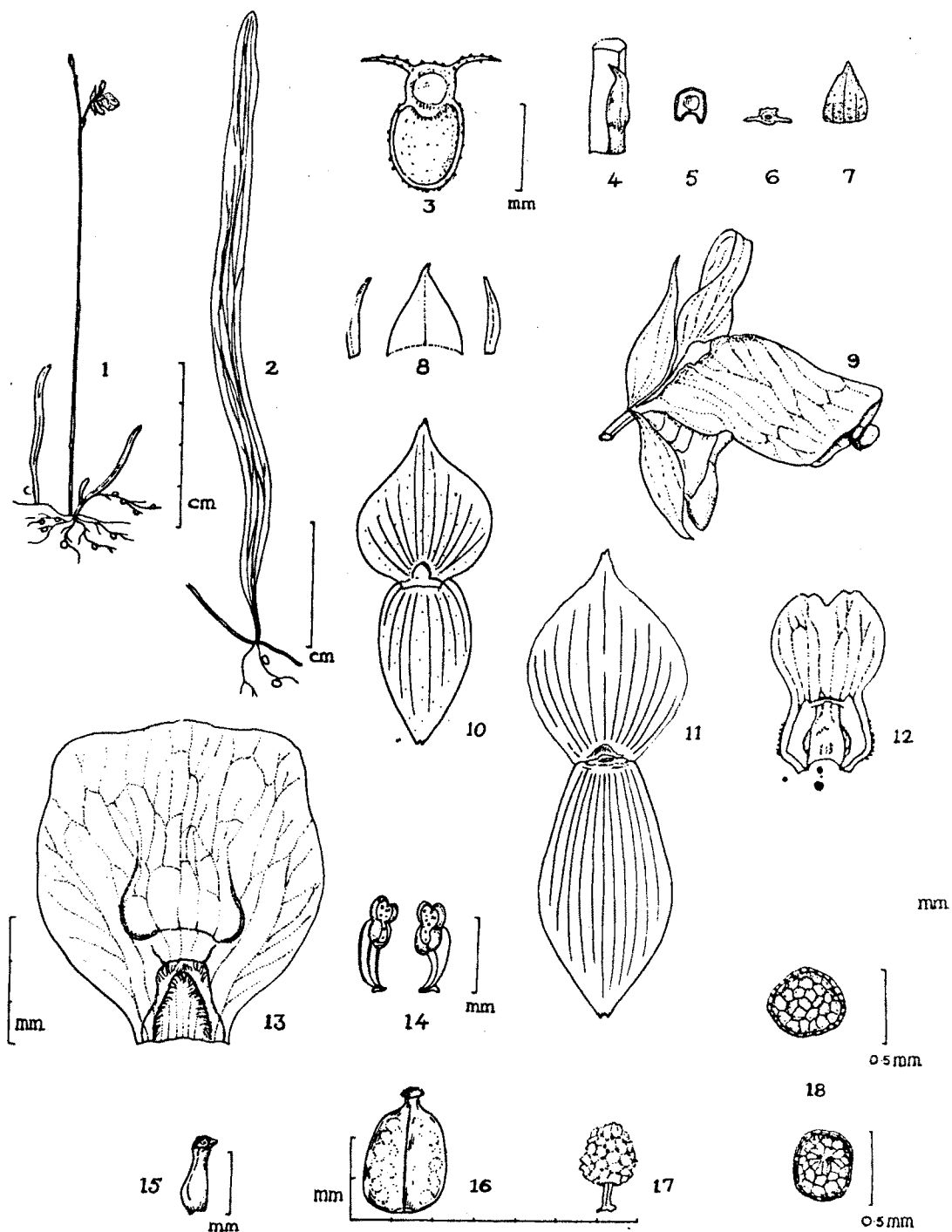
Utricularia nayarii M.K. Janarthanam & A. N. Henry sp. nov.

U. graminifolia Vahl affinis sed calcarum brevius; pariete capsulae aequae membranaceae; testa scrobiculata et cellulis testae plus minusve isodiametris differt.

Small annual herbs. Rhizoids up to 20 mm long, c 0.25 mm thick at the base, capillary, glandular; branches up to 4 mm long, simple or branched further, papillose. Stolons up to 30 mm long, c 0.2 mm thick, capillary, terete, sparsely branched. Leaves up to 50 mm long, 1.0-2.5 mm wide, solitary at the base of scape and at each stolon node; petioles attenuate; lamina linear, often forked, multinerved, rounded at apex. Traps 1.0-1.5 mm across, few, on the vegetative organs, globose; stalk short, distally thickened; mouth basal; appendages 2, subulate, simple, glandular. Inflorescence 5-18 cm long, solitary, erect; peduncle 0.5-0.75 mm thick, glabrous, angular, grooved on one side. Scales 1-4, similar to the bracts. Bracts up to 2.2 × 1.8 mm, basifixed, broadly ovate-deltoid, acuminate at apex, 1-nerved; bracteoles up to 1.8 mm long, subulate. Flowers 1-5; pedicels 3-5 mm long, winged, erect at anthesis and spread in fruit. Calyx lobes unequal; upper lobe 2.5-5.0 × 3.0-4.0 mm, broadly ovate, acuminate at apex;

lower lobe 2.8-6.0 × 2.2-3.3 mm, slightly longer and narrower than the upper lobe, linear-ovate, more or less elliptic in fruit, minutely bi-or tridentate at apex. Corolla 5-8 mm long, white - violet; upper lip 4.0-4.5 mm long, longer than calyx lobe, more or less constricted below the middle; upper limb slightly wider than the lower limb, rounded-emarginate at apex; lower lip 4.5-7.5 × 5.0-7.0 mm, orbicular-obovate, throat yellow; base prominently gibbous, white with violet reticulations, palate hairy, rounded-wavy at apex; spur rarely exceeds calyx lobe in length, conical, slightly curved, obtuse or notched with globose glands near the apex within. Staminal filaments c 1.2 mm long, slightly curved; anther thecae distinct. Pistil c 1.3 mm long; ovary ovoid, dorsiventrally compressed; style short; stigma bilipped, lower lip truncate, upper semiorbicular. Capsules c 3 × 2 mm, ovoid, the wall uniformly membranous, dehiscing by dorsal and ventral longitudinal slits; placentum c 1.5 mm long, ovoid, stalked. Seeds c 0.5 mm across, few, subglobose, often angled; testa thick, scrobiculate, reticulate, cells more or less isodiametric.

Holotype: *M. K. Janarthanam* 82963 (CAL) and Isotypes *M. K. Janarthanam* 82963 (MH acc. no. 136879-136882)



Utricularia nayarii Janarthanam & Henry sp. nov.

Figs. 1-18 : 1. Habit. 2. Leaf. 3. Trap. 4. A portion of peduncle with scale. 5. T.S. of peduncle. 6. T.S. of pedicel. 7. Scale. 8. Bract & bracteoles. 9. Flower. 10. Flowering calyx. 11. Fruiting calyx. 12. Upper lip of corolla. 13. Lower lip of corolla. 14. Stamens. 15. Pistil. 16. Capsule. 17. Placenta. 18. Seeds

were collected on 12 December 1985 from Rajamallay, near Munnar in Idukki District, Kerala. Paratypes: *K. M. Sebastine* 17543 & 17545 (CAL, MH) were collected at an altitude of 1675 m on 12 October 1963 from Lockhart gap near Munnar in the same district.

A terrestrial, on dripping rocks laden with Moss, in association with *Eriocaulon* sp., *Impatiens* sp. and grasses; flowering in October-December.

We are pleased to dedicate this species to Dr. M. P. Nayar, Director, Botanical Survey of India for his significant contribu-

tion to the Plant Taxonomy and Phytogeography of the Indian subcontinent.

Utricularia nayarii resembles *U. graminifolia* Vahl at first sight, but is quite distinct in its flowers having shorter spur, the capsule wall uniformly membranous and the testa scrobiculate with cells more or less isodiametric.

ACKNOWLEDGEMENTS

We are thankful to Dr. V. J. Nair, Botanical Survey of India for Latin translation and Mrs. C. P. Malathi for the line drawings.

NEOTYPIFICATION OF *UTRICULARIA PURPURASCENS* GRAHAM (LENTIBULARIACEAE)

M.K. JANARTHANAM AND A.N. HENRY

Botanical Survey of India, Southern Circle, Coimbatore-641 003

Utricularia purpurascens Graham (Cat. Pl. Bombay 165. 1839) was validly published on the basis of materials observed in Mahabaleshwar. John Graham's catalogue, in general, did not deal with dried specimens in a herbarium. In the absence of original materials preserved in any of the herbaria, *Janarthanam 82941* (MH) collected from the type locality after a lapse of about 150 years is designated as the neotype of this species.

Utricularia arcuata Wight (Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849 & Ic. t. 1571. f. 1. 1850) described from the materials collected in Belgaum by Lawson (73, K) has since been proved conspecific with *U. purpurascens* Graham.

Utricularia purpurascens Graham, Cat. Pl. Bombay 165. 1839; Chandrasekaran in Henry et al. Fl. Tamil Nadu I, 2: 130. 1987.

U. arcuata Wight in Hooker's J. Bot. Kew Gard. Misc. 1: 372. 1849 & Ic. t. 1571. f. 1. 1850; Oliver in J. Proc. Linn. Soc. Bot. 3: 177. 1859; Dalz. & Gibs. Bombay Fl. 136. 1861; Drury, Handb. Ind. Fl. 2: 121. 1866; Clarke in Hook. f. Fl. Brit. India 4: 330. 1884; Cooke, Fl. Bombay 2: 318. 1905 (2: 391. 1958 repr. ed.); Santapau in J. Bombay Nat. Hist. Soc. 49: 218. 1950 & Rec. Bot. Surv. India 16: 188. 1967; Shah, Fl. Gujarat 1: 54. 1978; Sharma et al. Fl. Karnataka 195. 1984; Rao, Fl. Goa 2: 308. 1986.

NEOTYPE: INDIA. Maharashtra: Satara District, Mahabaleshwar, 5.10.1985, *M. K. Janarthanam 82941* (MH).

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54071

